START

009168

DOCUMENT CLEARANCE REQUEST

Part 1 – Issuing Manager's Approval

1. Date Clearance Required 8/4/89	2. Document Identification WHC-SD-WM-SAR-032	2B. Previous Document Identification

3. Title (Include UC Category) Safety Analysis Report for Salt Well Waste Receiver Facilities	4. Author's Name(s) J. L. Foster	5. Phone 3-5629	6. MSIN R1-51

7. Desired Clearance/Release — Public Clearance ☐ Open Literature ☐ Oral Public — Limited Clearance ☐ Applied Technology ☐ Foreign Exchange — DOE Directed Release ☐ FOIA ☐ Media ☒ Other

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11. WHC Program: WB95A

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21. DOE/HQ Assistant Secretary For:

22. Remarks Being cleared in response to request from Ecology dated May 22, 1989 correspondence number 8902163B

Document is approved as conforming to all applicable requirements. The above information is certified to be correct.

	23. Author	Immediate Manager	Issuing Manager (Level III)	24. Date
Type Name	J. L. Foster	G. J. Dunford	R. J. Baumhardt	7/31/89
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Part 2 – Clearance Reviews and Approvals

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BD-7600-062R (06/88)

DISTRIBUTION SHEET

To	From	
Tank Farms Plant Engineering	Tank Farms Plant Engineering	Page 1 of 1
		Date 12/20/88
Project Title/Work Order: Safety Analysis Report for DCRTs/WB		EDT No 101646
		ECN No N/A

Name	MSIN	With Attach.	EDT/ECN & Comment	EDT/ECN Only
U. S. Department of Engery				
G. J. Bracken	A7-50	*		
R. E. Gerton	A6-80	*		
S. K. Moy	A6-80	*		
Westinghouse Hanford Company				
A. T. Alstad	R1-51	*		
D. G. Baide	R1-51	*		
R. J. Baumhardt	R2-40	*		
T. L. Bennington (3)	S1-52	*		
L. M. Bergmann	R1-51	*		
T. L. Blankenship	R2-40	*		
F. E. Boyd	S5-04	*		
W. G. Brule	S5-02	*		
B. E. Campbell	R1-51	*		
H. F. Daugherty	R2-53	*		
G. L. Dunford (5)	R1-51	*		
J. A. Eacker	R1-51	*		
J. L. Foster	R1-51	*		
J. P. Hinckley	R3-02	*		
R. A. Holten	A5-55	*		
J. P. Mollusky	R1-51	*		
K. J. Moss (3)	R3-08	*		
R. J. Nicklas	R1-51	*		
A. R. Schade	R3-09	*		
C. M. Winkler	R1-51	*		
L. J. SCHMIDT	S0-05	*		
J. J. Zimmer	R2-05	*		

A-6000-135 (12 87)

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ENGINEERING DATA TRANSMITTAL (EDT)

Page 1 of ___

(1) EDT 101646

(2) To (Receiving Organization)
Tank Farms Plant Engineering

(3) From (Originating Organization)
Tank Farms Plant Engineering

(4) Related EDT No. 100629 ~~101602~~ 101689 100602 JLF 2-13-89

(5) Proj./Prog./Dept./Div.
WB/WM

(6) Cog./Proj. Engineer
J. L. Foster/J. A. Eacker

(7) Purchase Order No.
N/A

(8) Originator Remarks
This document, along with SD-WM-SAR-033 (EDT No. 101689), JLF 3-6-89 replaces RHO-CD-1097 in its entirety. This change allows revision to the Safety Analysis Report. OSR deletions have also been incorporated into this change.

(9) Equip/Component No.
N/A

(10) System/Bldg./Facility
Tank Farms

(11) Receiver Remarks
This EDT is Impact Level ~~4~~ since this is purely an administrative change. The OSR deletions were already functionally approved per WHC EDT 100602 and 100629 JLF 3-6-89 and DOE letter 8900488B.

3/21/89 3/6/89

(12) Major Assm. Dwg. No.
N/A

(13) Requied Response Date
February 17, 1989

(14) DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sht. No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	SD-WM-SAR-032	-	0	Safety Analysis Report - Salt Well Waste Receiver Facilities	~~4~~ 3/21/89 3/6/89	2	1	1

(15) KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) and (I)
1, 2, 3, or 4 see MRP 5.43 and EP 1.7	1. Approval 2. Release 3. Information 4. Review 5. Post-Review	1. Approved 2. Approved w/Comment 3. Disapproved w/Comment 4. Reviewed – No Comment 5. Reviewed – w/Comment 6. Receipt Acknowledged

(15) SIGNATURE/DISTRIBUTION
(SEE IMPACT LEVEL FOR REQUIRED SIGNATURES)

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1	1	J. A. Eacker	JA Eacker	2/13/89					
1	1	J. L. Foster	J. L. Foster	2-13-89					
1	1	D. G. Baide	DG Baide	2/13/89					
1	1	T. L. Bennington	[illegible]	3/10/89					
1	1	K. J. Moss	[illegible]	3/11/89					
1	1	G. L. Dunford	[illegible]	3/10/89					

(17) Jim L. Foster 2-13-89
Signature of EDT Originator/Date

(18) DG Baide 2/13/89
Authorized Representative for Receiving Organization/Date

(19) DG Baide 2/13/89
Cognizant Project Engineer's Manager/Date

(20) DOE APPROVAL (If Required)
LTR No. 8900488B
☒ Approved
☐ Approved w/Comments
☐ Disapproved w/Comments

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ENGINEERING DATA TRANSMITTAL (EDT)

(USE BLACK INK OR TYPE)

(1) EDT 100602

(2) To: (Receiving Organization)
Tank Farm Plant Engineering

(3) From: (Originating Organization)
Tank Farm Plant Engineering

(4) Related EDT No:
NA

(5) Proj/Prog/Dept/Div:
WC/OSR Deletion Package

(6) Cog/Proj Engr:
A.T. Alstad

(7) Purchase Order No:
NA

(8) Originator Remarks:
This Operations Safety Requirements (OSR) package identifies OSRs contained in Single Shell Tank Safety Analysis Reports that do not meet the requirements to be OSRs and should therefore be deleted.

(9) Equip/Component No:
NA

(10) System/Bldg/Facility:
Single Shell Tanks

(11) Receiver Remarks:

(12) Major Assm Dwg No:
NA

(13) Required Response Date:
April 15, 1988

(14) DATA TRANSMITTED

(A) Item No.	(B) Document/ Drawing, No.	(C) Sht. No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	RHO-CD-1097	ALL	0	OSR Deletion Package	1	4	4	4
2	RHO-CD-1415	ALL	0	OSR Deletion Package	1	4	4	4

(15) KEY

Impact Level (F)
1, 2, 3, or 4 see MRP 5.43 and EP 1.7

Reason for Transmittal (G)
1. Approval
2. Release
3. Information
4. Review
5. Post-Review

Disposition (H) & (I)
1. Approved
2. Approved w/comment
3. Disapproved w/comment
4. Reviewed no/comment
5. Reviewed w/comment
6. Receipt acknowledged

(16) SIGNATURE/DISTRIBUTION
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(G) Reason	(H) Disp	(J) Name	(K) Signature	(L) Date	(J) Name	(K) Signature	(L) Date	(G) Reason	(H) Disp
4	4	A.T. Alstad	Allen T. Alstad	4-13-88	A.B. Fee	A.B. Fee	4/14/88	4	5
4	4	D.R. Groth	D R Groth	4-13-88	R.A. Zinsli	R A Zinsli	4-14-88	4	5
4	5	C.A. Carro	C A Carro	4-13-88	D.R. Ellingson	D Ellingson	4/14/88	4	5
4	4	D.K. Oestreich	D.K. Oestreich	4-14-88					
4	5	G.L. Jones	L.B. Jones	4-18-88					
4	4	G.H. Rust	G H Rust	4-15-88					
4	5	R.B. Bendixsen	R.B. Bendixsen	4-14-88					

(17) Joel A. Eacker 4/13/88
Signature of EDT Originator — Date

(18) Joel A Eacker 4/18/88
Authorized Representative for Receiving Organization — Date

(19)
Cognizant/Project Engineer's Manager — Date

(20) DOE APPROVAL (if required)
LTR No.
☐ Approved
☐ Approved w/comments
☐ Disapproved w/comments

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ENGINEERING DATA TRANSMITTAL (EDT)
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Page 1 of 1

(1) EDT 100629

(2) To: (Receiving Organization)
Tank Farm Plant Engineering

(3) From: (Originating Organization)
Tank Farm Plant Engineering

(4) Related EDT No:
100602

(5) Proj/Prog/Dept/Div:
WC/ OSR Deletion Package

(6) Cog/Proj Engr:
A.T. Alstad

(7) Purchase Order No:
NA

(8) Originator Remarks:
This Operations Safety Requirements (OSR) package identifies OSRs contained in Single Shell Tank Safety Analysis Reports that do not meet the requirements to be OSRs and should therefore be deleted.

Functional review has been completed with all comments dispositioned

(9) Equip/Component No:
NA

(10) System/Bldg/Facility:
Single Shell Tanks

(11) Receiver Remarks:

(12) Major Assm Dwg No:
NA

(13) Required Response Date:
April 29, 1988

(14) DATA TRANSMITTED

(A) Item No.	(B) Document/ Drawing, No.	(C) Sht. No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	RHO-CD-1097	All	0	OSR Deletion Package	1	1	1	1
2	RHO-CD-1415	All	0	OSR Deletion Package	1	1	1	1

(15) KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 see MRP 5.43 and EP 1.7	1. Approval 2. Release 3. Information 4. Review 5. Post-Review	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

(16) SIGNATURE/DISTRIBUTION
(See Impact Level for required signatures)

(G) Reason	(H) Disp	(J) Name	(K) Signature	(L) Date	(J) Name	(K) Signature	(L) Date	(G) Reason	(H) Disp
1	1	A.T. Alstad	Allen T. Alstad	4-15-88	D.R. Groth	DR Groth	4-15-88	1	1
1	1	G.L. Dunford	GL Dunford	4/18/88					
1	1	G.L. Jones	GL Jones	4-18-88					
1	1	D.R. Ellingson	LET D R Ellingson	4-18-88					
1	1	G.D. Forehand	[illegible]	5/3/88					
1	1	R.B. Gelman	[illegible]	4/25/88					
1	1	F.E. Boyd	F E Boyd	4/20/88					

(17) Joel Alack 4/15/88
Signature of EDT Originator — Date

(18) [signature] 5/3/88
Authorized Representative for Receiving Organization — Date

(19) [signature] 5/3/88
Cognizant/Project Engineer's Manager — Date

(20) DOE APPROVAL (If required)
LTR No.
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Page 1 of 1

ENGINEERING DATA TRANSMITTAL (EDT)

(1) EDT 101689

(2) To (Receiving Organization) Tank Farms Plant Engineering	(3) From (Originating Organization) Tank Farms Plant Engineering	(4) Related EDT No. ~~N/A~~ 101646 100629 100602
(5) Proj./Prog./Dept./Div. WB/WM	(6) Cog./Proj. Engineer J. L. foster	(7) Purchase Order No. N/A

(8) Originator Remarks This document * replaces the addendum (No. 1) to RHO-CD-1097 in its entirety. The addendum could not be revised in its current form and therefore is being converted to a SD. (Safety Equipment Lists must be added to the SAR per WHC-CM-4-46). OSR deletions have also been incorporated into this change.
* along with SD-WM-SAR-032 (EDT No. 101646), 3-6-89

(9) Equip/Component No. N/A

(10) System/Bldg./Facility Tank Farms

(11) Receiver Remarks This EDT will be Impact Level ~~4~~ 2 since this is purely an administrative change. The OSR deletions were already functionally approved per WHC EDT 100602 and 100629 and DOE letter 8900488B. 3-6-89

(12) Major Assm. Dwg. No. N/A

(13) Requied Response Date N/A

(14) DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sht. No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	SD-WM-SAR-~~003~~ 033 2-13-89	-	0	Safety Analysis Report For 241-A-350 Catch Tank	~~4~~ 2	2	1	1

(15) KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) and (I)
1, 2, 3, or 4 see MRP 5.43 and EP 1.7	1. Approval 2. Release 3. Information 4. Review 5. Post-Review	1. Approved 2. Approved w/Comment 3. Disapproved w/Comment 4. Reviewed - No Comment 5. Reviewed - w/Comment 6. Receipt Acknowledged

(15) SIGNATURE/DISTRIBUTION
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(G) Reason	(H) Disp	(J) Name	(K) Signature	(L) Date	(J) Name	(K) Signature	(L) Date	(G) Reason	(H) Disp
2	1	J. L. Foster	Jim L. Foster	2-12-89					
2	1	D. G. Baide	D G Baide	2/13/89					
2	1	T. L. Bennington	T L Bennington	3/10/89					
2	1	K. J. Moss	for	3/7/89					
2	1	G. L. Dunford	[illegible]	3/10/89					

(17) Jim L. Foster 2-12-89
Signature of EDT Originator/Date

(18) D G Baide 2/13/89
Authorized Representative for Receiving Organization/Date

(19) D G Baide 2/13/89
Cognizant Project Engineer's Manager/Date

(20) DOE APPROVAL (If Required)
LTR No. 8900488B
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SUPPORTING DOCUMENT

Title	Number	Rev No	Page
Safety Analysis Report for Salt Well Waste Receiver Facilities	SD-WM-SAR-032	0	A

Key Words DCRT, Tank Farms, 244-A, 244-BX, 244-CR, 244-S, 244-TX, 244-U, Safety Analysis Report

Author

Jim L. Foster
Signature

13331
Organization Code

Abstract

This Safety Analysis Report replaces RHO-CD-1097 in its entirety. The document number is changed strictly to provide a method of revising the SAR (eg. w/Safety Equipment Lists). OSRs 11.2.2, 11.3.2, 11.3.3, 11.4.1, 11.4.2, and 11.6.1 have been deleted.

JLF
2-13-89

Impact Level 1

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	INITIAL RELEASE AND CHANGE CONTROL RECORD	(2) Document Number SD-WM-SAR-032	
		INITIAL RELEASE	
(1) Title Safety Analysis Report for Salt Well Waste Receiver Facilities		(3) Cognizant/Project Engineer J. L. Foster *J. L. Foster*	Date 2-13-89
		(4) Cognizant/Project Manager D. G. Baide *D G Baide*	Date 2/13/89
		(5) EDT Number 101646	Revision 0

CHANGE CONTROL RECORD

(6) Revision	(7) Description of Change – Replace, Add, and Delete Pages	Authorized for Release (8) Cog./Proj. Engr.	(9) Cog./Proj. Mgr.	Date

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SD-WM-SAR-032
REV 0

SAFETY ANALYSIS REPORT
SALT WELL WASTE RECEIVER FACILITIES

G. L. Hanson
R. R. Jackson
J. R. LaRiviere

Safety Analysis Reports Group
Health, Safety and Environment

December 1980

Prepared for the United States
Department of Energy
Under Contract DE-AC06-77RL01030

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Document Number SD-WM-SAR-032 REV 0

Title: SAFETY ANALYSIS REPORT
SALT WELL WASTE RECEIVER FACILITIES

Issue Approval:

G. L. Hanson — 2/23/81

Author — Date

2/23/81

Issuing Manager — Date

2/23/81

Concurring Approval — Date

2/23/81

Program Representative — Date

2/24/81

Program Office — Date

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APPROVED BY [signature] 12/5/80

D. C. Bartholomew, Director
Production Operations

Date

APPROVED BY [signature] 12/4/80

P. G. Lorenzini, Director
Health, Safety, and Environment

Date

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1.0 INTRODUCTION

A large volume of the stored liquid radioactive waste from spent fuels reprocessing and other 200 Areas' operations has been concentrated to produce wet salt cake, containing approximately 45% interstitial liquor and a supernatant solution. After transfer of the supernatant, salt wells, installed in the salt cake, are used to pump the interstitial liquor and supernatant heel to other single-shell waste collection tanks.

Rockwell Hanford Operations (Rockwell) has a commitment to discontinue the use of single-shell tanks for radioactive liquid waste storage after CY 1980. To implement this goal, new double-containment receiver tanks (DCRT), 244-S (Project B-135), 244-BX, 244-TX, and 244-U (Project B-180), and associated equipment were provided for collection and transfer of salt well wastes and other wastes generated after CY 1980. Project B-180 also provided modifications to the existing 244-CR vault and the 241-AN-101 tank to permit their use for collection and transfer of these wastes. The 244-A lift station (previously provided by Project B-103) is similar in design and service to the 244-S facility and will also be used in the waste collection and transfer operations.

This safety analysis report has been prepared by Rockwell in compliance with the U.S. Department of Energy (DOE) requirements. Identified hazards and postulated accidents associated with operation of the salt well waste receiver facilities have been analyzed for potential impacts on the environment and on the health and safety of employees and the general public.

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2.0 SUMMARY SAFETY ANALYSIS

The impact of natural phenomena and that of normal and accident conditions during the planned operation of the salt well waste receiver facilities for receipt and handling of salt well liquor and other radioactive liquid wastes has been reviewed and analyzed. It is concluded that the planned operations can be conducted without undue risk to the health and safety of employees, the general public, and the environment.

2.1 IMPACT OF NATURAL EVENTS

The 244-A, 244-BX, 241-AN-101, 244-S, 244-TX, and 244-U salt well waste receiver facilities were designed and constructed to assure an orderly and safe shutdown during and after an earthquake having a maximum horizontal ground acceleration of 0.25 g accompanied by a vertical acceleration of two-thirds the horizontal. The 244-CR facility was not designed or constructed to meet this criteria and no analysis has been performed to determine its earthquake resistance.

The frequency and severity of natural events (earthquake, tornado) which may be experienced at the Hanford Site are described in References 1 and 2. The most serious accident postulated during operation of the salt well waste receiver facilities is the occurrence of a 0.25-g earthquake which damages the 244-CR facility, its exhaust ventilation and the 15,000-gallon 003-CR tank, which is filled with salt well liquor. It was calculated that 7.6 Ci of ^{137}Cs, 0.15 Ci ^{90}Sr, and 6.1×10^{-4} Ci ^{239}Pu would be released to the environs as the result of this accident (see Section 9.3.4). Calculated dose commitments resulting from this release are shown in Table 11. The annual risk associated with a 0.25-g earthquake is shown in Table 1.

Should a tornado strike these facilities, the above-grade instrument shelters and ventilation exhaust stacks could be destroyed or damaged without release of radioactive materials. The below-grade high efficiency particulate air (HEPA) filters are protected from the effects of a tornado by 2-foot-thick, reinforced-concrete cover blocks, except for those on the 244-A and 244-S facilities, which are covered by a 3/8-inch steel plate. Since these two facilities are approximately 5 miles apart, the probability for both to be damaged is very low. Destruction of the HEPA filters at either facility, or at the previously analyzed 241-AN Tank Farm (101-AN), could result in the release of the radioactive particulate filter inventory. Consequences would be similar to those calculated for the filter failure accident (9.3.1). The annual risk associated with a tornado is shown in Table 1.

2.2 RADIOLOGICAL IMPACT OF NORMAL OPERATIONS

Earth, steel, and reinforced concrete provide radiation shielding for these below-grade facilities and their associated waste transfer lines to reduce radiation exposure to ≤0.5 mR/hr. During normal operations, ventilation exhaust gases are treated via two stages of HEPA filtration, monitored, and continuously sampled for radioactive particulate content to ensure that radioactive releases to atmosphere are below DOE MC-0524 Appendix Annex A, Table II Concentration Guides.(3) All radioactive liquid wastes, including any leakage from transfer lines or the receiver facilities provided or modified by Projects B-135 and B-180 and from 244-A, flushes, etc., will be contained and routed to double-shell, underground waste storage tanks. Solid radioactive wastes generated by operation and maintenance of these facilities will be packaged, handled and buried in accordance with Hanford requirements.(4)

The offsite radiation dose to the average individual from the entire Hanford Site operation for CY 1979 has been estimated at 0.005 mrem/yr.(5) The incremental contribution to this offsite radiation dose resulting from normal operation of the salt well waste receiver facilities would be unmeasureable.

2.3 RADIOLOGICAL IMPACT FROM ACCIDENTS AND ABNORMAL OPERATIONS

Postulated accidents which could result in the release of radioactive materials to the environs have been analyzed in Section 9.3. Calculated dose commitments to the maximum offsite individual and to the offsite population resulting from a filter failure accident and from a 0.25-g earthquake, shown in Tables 9 and 11, are within limits specified in DOE MC-0524.(3)

TABLE 1. Offsite Risk Due to Accidents - Salt Well Receiver Operations.

Dose Commitment Risks, Man-rem/yr(a)

Accident	Atmospheric Release (Ci)	Frequency Per Year	Risk (Release x Frequency) (Ci)	1 Yr. Max. Individual		1 Yr. Population		70 Yr. Max Individual		70 Yr. Population	
				Bone	Lung	Bone	Lung	Bone	Lung	Bone	Lung
Filter	0.01 ^{90}Sr	$4.9x10^{-5}$(b)	$4.9x10^{-7}$ ^{90}Sr(b)	$1.4x10^{-8}$	$1.2x10^{-8}$	$2.8x10^{-5}$	$1.2x10^{-5}$	$5.9x10^{-7}$	$2.8x10^{-8}$	$1.1x10^{-3}$	$2.8x10^{-5}$
Failure	0.69 ^{137}Cs $5.6x10^{-4}$ ^{239}Pu		$3.4x10^{-5}$ ^{137}Cs(b) $2.7x10^{-8}$ ^{239}Pu(b)	$3.7x10^{-7}$ $9.8x10^{-9}$	$6.4x10^{-8}$ $5.4x10^{-8}$	$1.0x10^{-3}$ $9.8x10^{-6}$	$1.7x10^{-4}$ $5.4x10^{-5}$	$8.3x10^{-7}$ $4.9x10^{-7}$	2.0710^{-7} $1.4x10^{-7}$	$2.2x10^{-3}$ $4.9x10^{-4}$	$6.9x10^{-4}$ $1.4x10^{-4}$
Earthquake	0.15 ^{90}Sr	$7x10^{-4}$	$1.0x10^{-4}$ ^{90}Sr	$3.1x10^{-7}$	$2.5x10^{-6}$	$6.1x10^{-3}$	$2.5x10^{-3}$	$1.3x10^{-4}$	$6.0x10^{-6}$	$2.4x10^{-1}$	$6.0x10^{-3}$
244-CR Vault	7.6 ^{137}Cs $6.1x10^{-4}$ ^{239}Pu		$5.3x10^{-3}$ ^{137}Cs $4.3x10^{-7}$ ^{239}Pu	$5.9x10^{-5}$ $1.5x10^{-7}$	$9.8x10^{-6}$ $8.4x10^{-7}$	$1.6x10^{-1}$ $1.5x10^{-4}$	$2.7x10^{-2}$ $8.4x10^{-4}$	$1.3x10^{-4}$ $7.7x10^{-6}$	$4.3x10^{-5}$ $2.2x10^{-6}$	$3.6x10^{-1}$ $7.7x10^{-3}$	$1.1x10^{-1}$ $2.2x10^{-3}$
Pump Pit and Receiver Tank Breach	$3.0x10^{-4}$ ^{90}Sr $1.5x10^{-2}$ ^{137}Cs $1.2x10^{-5}$ ^{239}Pu	$7.2x10^{-5}$	$2.2x10^{-8}$ ^{90}Sr $1.1x10^{-6}$ ^{137}Cs $8.6x10^{-10}$ ^{239}Pu								
Tornado	0.01 ^{90}Sr 0.69 ^{137}Cs $5.6x10^{-4}$ ^{239}Pu	$6x10^{-6}$	$6x10^{-8}$ ^{90}Sr $4.1x10^{-6}$ ^{137}Cs $3.4x10^{-9}$ ^{239}Pu								

(a) Frequency x dose commitments from Section 9.3

(b) Frequency per HEPA filter year

Accidents examined, together with estimated radionuclide releases, frequencies, and calculated dose commitment risks are shown in Table 1. Inspection of this table shows that the maximum risk accident is that resulting from an earthquake which damages the 244-CR vault. Dose commitment risks for breach of a pump pit and catch tank and for a tornado were not calculated; however, such risks are significantly lower than for the earthquake or filter failure since the probability (frequency) of occurrence is significantly lower.

3.0 SITE CHARACTERISTICS

3.1 GEOGRAPHY AND DEMOGRAPHY

The salt well waste receiver facilities are located inside the fenced 200 Areas, near the center of the approximately 570-square mile, federally owned Hanford Site shown in Figure 1. The 200 East Area and the approximate locations of the 244-A lift station, 244-BX receiver station, 244-CR vault, and the 241-AN-101 tank are shown in Figure 2. The 244-S, 244-TX, and 244-U receiver stations are located in the 200 West Area as shown in Figure 3. Detailed geographic characteristics of the site are presented in Reference 1.

The 1970 population living within a 50-mile radius of the Hanford Meteorological Station, northeast of the 200 West Area, was 245,000.(1) However, a more recent study gives an estimated population of 290,000 by 1990.(6) The onsite work force population is described in Reference 7. Land uses in the surrounding area include urban and industrial, plus irrigated and dry land farming.

3.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

Since the salt well waste receiver facilities are located near the center of the Hanford Site, there are no nearby industrial or military facilities except for the DOE-controlled or leased facilities within the site boundaries. Public transportation facilities nearest to the 200 Areas are State Highways 24 and 240 (Figure 1). Nuclear facilities within 25 miles of the 200 Areas are the Exxon Nuclear Fuel Fabrication Plant located in Richland, three Washington Public Power Supply System reactors under construction, the Nuclear Engineering Company low-level waste burial ground. The DOE facilities located within the Hanford Site and described in Reference 1. The eastern boundary of the nearest military facility, the Yakima Firing Center, is approximately 25 miles northwest of the 200 West Area.

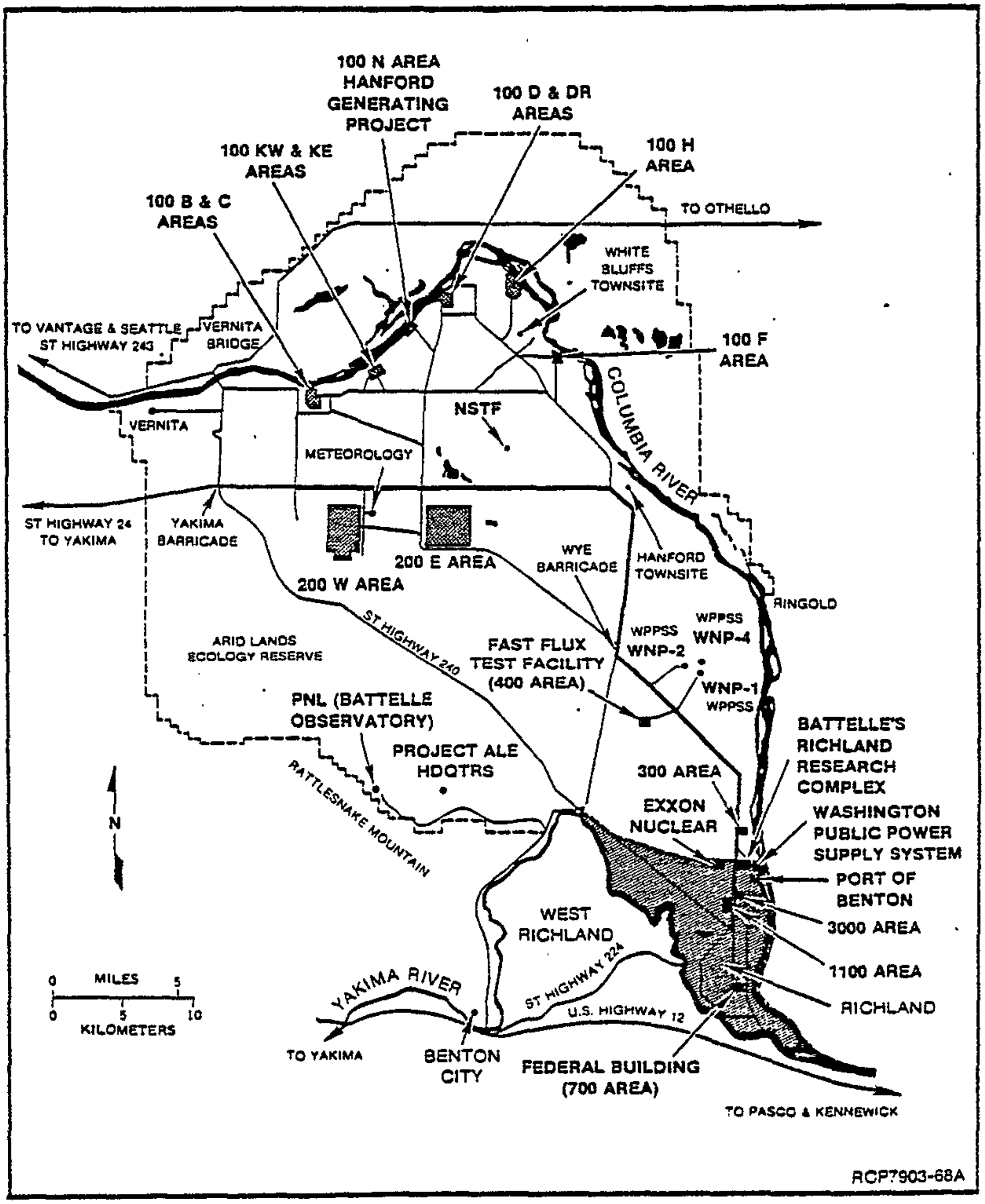

FIGURE 1. Hanford Site Department of Energy.

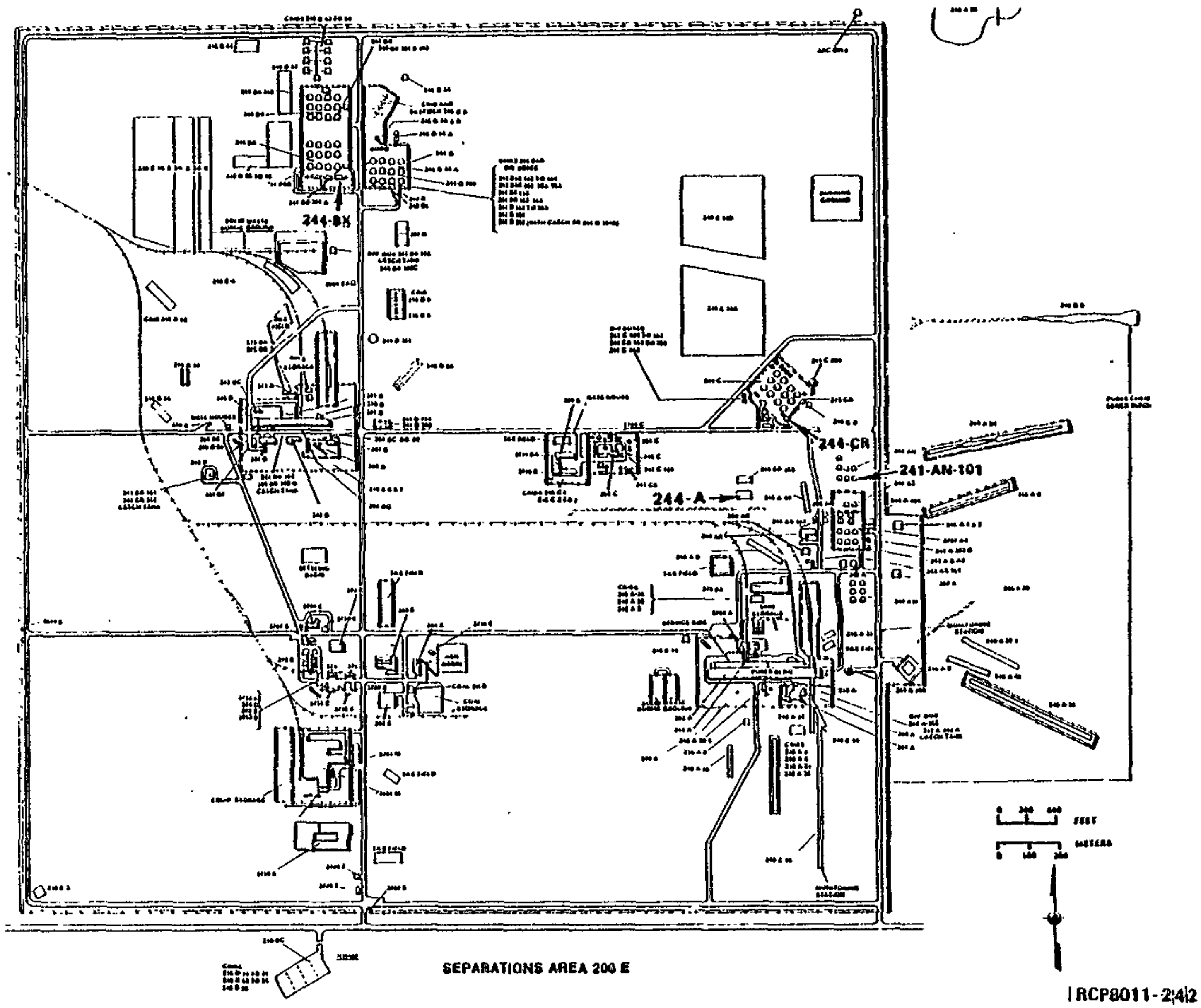

FIGURE 2. 200 East Area.

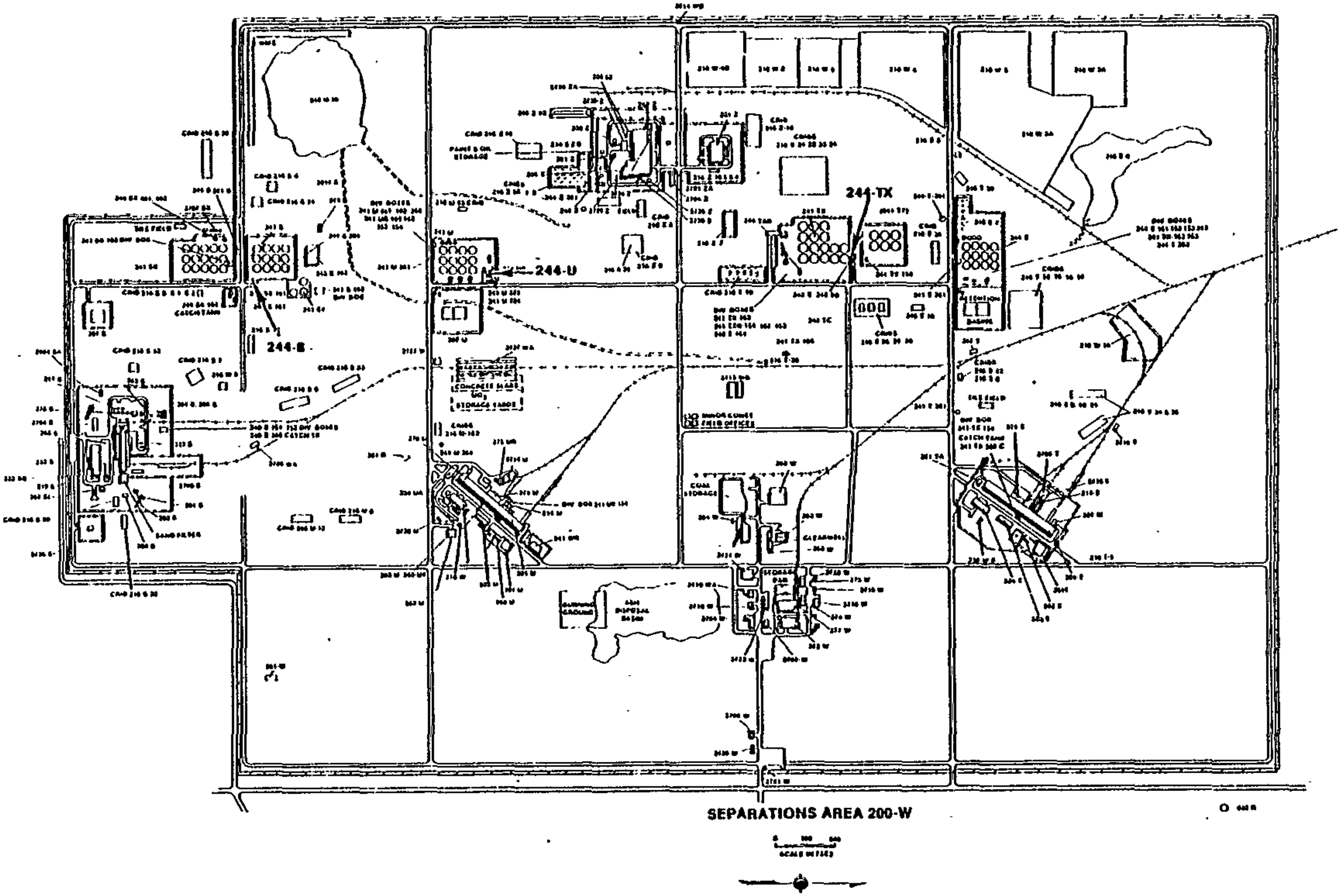

FIGURE 3. 200 West Area.

3.3 CLIMATOLOGY AND METEOROLOGY

The climate in the vicinity of Hanford has been recorded since 1912 and is characterized as mild and dry with occasional periods of high wind.(1) A peak gust wind (straight) of 80 mph was measured on January 11, 1972, at the 50-foot level of Hanford Meteorlogical Station tower. The average annual precipitation is 6.25 inches. Tornadoes are rare in this region and tend to be small, causing only minor damage.(1) On June 16, 1948, a tornado was observed near the east end of Rattlesnake Mountain, approximately 10 miles south of Hanford's waste management facilities; no damage resulted. Water erosion associated with facilities located on the 200 Areas plateau is minor because of the minimal precipitation, high soil porosity, and lack of sufficient relief to initiate runoff.

3.4 SURFACE HYDROLOGY

The surface hydrology of the Hanford Site has been studied extensively.(1) These studies include not only an analysis of the Columbia and Yakima Rivers, but in-depth investigations as to the nature of a number of man-made ditches and ponds used for the disposal of low-level radioactive liquid waste, certain industrial waste, and cooling waters from various processes.

Neither the maximum expected rainfall over the next 1,000 years nor the effect of the 100-year probable flood of the Columbia River would pose any added hazard to the 200 Area operations.(1)

3.5 REGIONAL HYDROGEOLOGY

From a hydrologic standpoint, the regional geology of Hanford presents a series of confined aquifers (primarily basaltic interbeds of the Columbia River Group) overlain by an unconfined aquifer formed by permeable beds in the upper and middle Ringold Formation and in the Pasco gravels. Over 1,500 wells have been drilled to provide data for evaluating the chemical and physical properties of the underlying materials and to study movement of radioactive materials in soils.(1)

3.6 GEOSEISMOLOGY

Hanford facilities are exposed to the possibility of moderate earthquake damage (Zone 2) from both active seismic zones of western Washington and closer shocks originating in the seismic zone that includes Walla Walla.

The design basis earthquake of 0.25 g for the Hanford Site allows for an earthquake of an intensity of MM VIII on the Modified Mercalli scale, epicentered at the same site. This is considered conservative, since no earthquake of this magnitude has ever been recorded in eastern Washington or Oregon.[1]

The December 14, 1872 earthquake in the North Cascades, as reported by Coombs et al.,[8] is estimated to have resulted in an intensity of MM VI (approximately 0.05 g) at the Hanford Site. All other events attenuated to intensities of MM IV or less. The largest local earthquake of historical record occurred at Corfu, a few miles north of the site, in 1918. Various damage estimates have been reported resulting in a classification of MM IV or V. Estimates of the peak ground acceleration made for the Corfu event range from 0.01 to 0.03 g. Data indicate that no events larger than MM V to VI have occurred in the vicinity of the 200 Areas.

4.0 PRINCIPAL DESIGN CRITERIA

4.1 PURPOSE OF FACILITIES

The Rockwell Waste Concentration Program[9] requires the removal from waste storage tanks of supernatant heels and interstitial liquor associated with solids generated by past and current waste management programs. This is accomplished by salt well pumping via jet pumps, with their intakes located in screened salt wells which are imbedded in the solids (sludge/salt cake) in the underground waste storage tanks. The resultant waste liquor is accumulated in receiver tanks. From these tanks, the waste is transferred to storage or into the waste concentration system for volume reduction. The recent practice is to use existing single-shell waste tanks as the receiver tanks. Rockwell has a commitment to discontinue the use of single-shell tanks for liquid waste storage and processing after CY 1980. Consequently, alternate, double-containment receiver tanks (DCRT) have been provided as salt well receiver facilities for these wastes transferred after CY 1980.

The new DCRT installed are: 244-S, 244-TX, 244-BX, and 244-U. Existing tanks to be utilized as DCRT are: the CR-003 tank in the 244-CR vault (1952), the 241-AN-101 tank in the AN tank farm (1980), and the 244-A lift station (1975). Encased transfer lines have been provided to ensure the double containment of wastes pumped from the receiver tanks.[10,11,12]

With the installation of these DCRT and encased lines, provisions have been made to handle other wastes generated after CY 1980, thus permitting the removal from service of single-shell tanks and direct-buried lines.[13] In addition to salt well liquor, the 244-TX DCRT receives and transfers Z Plant neutralized waste. The 244-S DCRT receives salt well liquor, customer waste (until 204-AR is operational), U Plant and T Plant wastes, 222-S laboratory waste, drainage from the east-west waste transfer system, and may receive waste transfers from 244-TX. The 244-A lift station receives drainage from 241-A, B, BX, and BY waste transfer lines, drainage from the east-west waste transfer system, and may receive waste transfers from 244-BX and 244-CR-003. The 241-AN-101 tank will also receive condensate from the 241-A, AX, AY, AZ exhaust ventilation system.

4.2 STRUCTURAL AND MECHANICAL SAFETY CRITERIA

4.2.1 Natural Forces Resistant Designs

Natural forces resistance has been included in the designs of Hanford's waste management facilities over the past 30 years using state-of-the-art knowledge and applicable criteria at the time of the design. Natural forces resistance criteria (wind and seismic) are described herein.

- Winds. The facilities provided by Projects B-135 and B-180 have been designed to withstand translational (straight) wind forces in accordance with the Uniform Building Code (UBC), Section 2308, and Tables 23-F and 23-G, as applicable.[14] Existing facilities used as waste receivers were designed to meet UBC requirements in effect at the time of construction. Since tornadoes are rare in the Hanford region, tend to be small and result in little damage, these facilities were not designed to withstand rotational (tornado) wind forces. However, the receiver tanks, piping, and ventilation filtration systems are all below ground and thus not subjected to wind loadings.[11]

- Seismic. At the time the 244-CR vault was constructed (1952), below-ground waste tank structures were designed for: (1) static loads from soil backfill; (2) live loads on the ground above; and (3) internal hydrostatic pressures. These buried structures have considerable inherent earthquake resistance because they are stiff and strong, as required to support the backfill, and a properly placed backfill will restrict relative motions between the structure and ground during an earthquake.

  The primary tank, vault, pump pit, and process lines for the new salt well waste receiver facilities (244-S, 244-TX, 244-BX, and 244-U) and for the previously constructed 244-A facility and the 241-AN-101, double-shell, underground waste storage tank were designed to be capable of withstanding earthquake criteria defined in Hanford Plant Standard Design Criteria SDC-4.1, Category I.[15] Other systems are in compliance with criteria in the UBC[14] for seismic Zone 2.

4.2.2 Additional Design Features.

The 244-S tank vault was designed to contain potential leakage of solution from the primary tank. The tank vault is capable of withstanding all soil loadings, dead loads, seismic loads, and loads caused by temperature gradients between the radioactive wastes contained within the primary tank and the soil. The tank vault was designed to withstand the stresses created by the most severe combination of the following loads without loss of containment:

- earth cover and backfill compacted to maximum density
- uniform live loading of 40 lb/ft^2
- thermal loads caused by a temperature gradient induced by material in the primary tank at temperatures of up to 250°F.

The bottom of the tank vault is sloped to a sump for leak collection and detection. The inside diameter of the tank vault provides for penetrations in the annular space between the primary tank and the tank vault for liquid level detection devices, inspection equipment (such as periscopes and cameras), pumps, and ventilation air supply. In the event of a primary tank failure, the lined tank vault ensures that no radioactive materials escape to the soil.

The receiver tank is designed to withstand:

- up to 6 inches (water) vacuum
- maximum internal pressure of 60 inches (water)
- a hydrostatic load of a net volume of solution with 1.8 specific gravity
- load cycled from full to empty weekly for 10 years
- thermal cycling from 70° to 200°F weekly for 10 years under all hydrostatic load conditions.

The 244-A, 244-BX, 244-TX, and 244-U facilities are also designed and constructed to meet these criteria. Although the 244-CR vault and tanks were constructed in 1952, engineering judgment indicates that the facility will meet the above criteria. The 241-AN-101 tank, constructed in 1980, will also meet the above design criteria except for the weekly load and thermal cycling which are not applicable to this 1,000,000-gallon tank.

4.2.3 Water Level (Flood).

All of the tank farm facilities are located in the 200 Areas (200 East and 200 West). The 200 Areas is located on a relatively high plateau. A postulated probable maximum flood for the Columbia River Basin is presented in Reference 1. The potential flooded areas within the Hanford Site are shown in Figure 4. The 200 Areas plateau is above the potential flooded area and, hence, would not be affected.

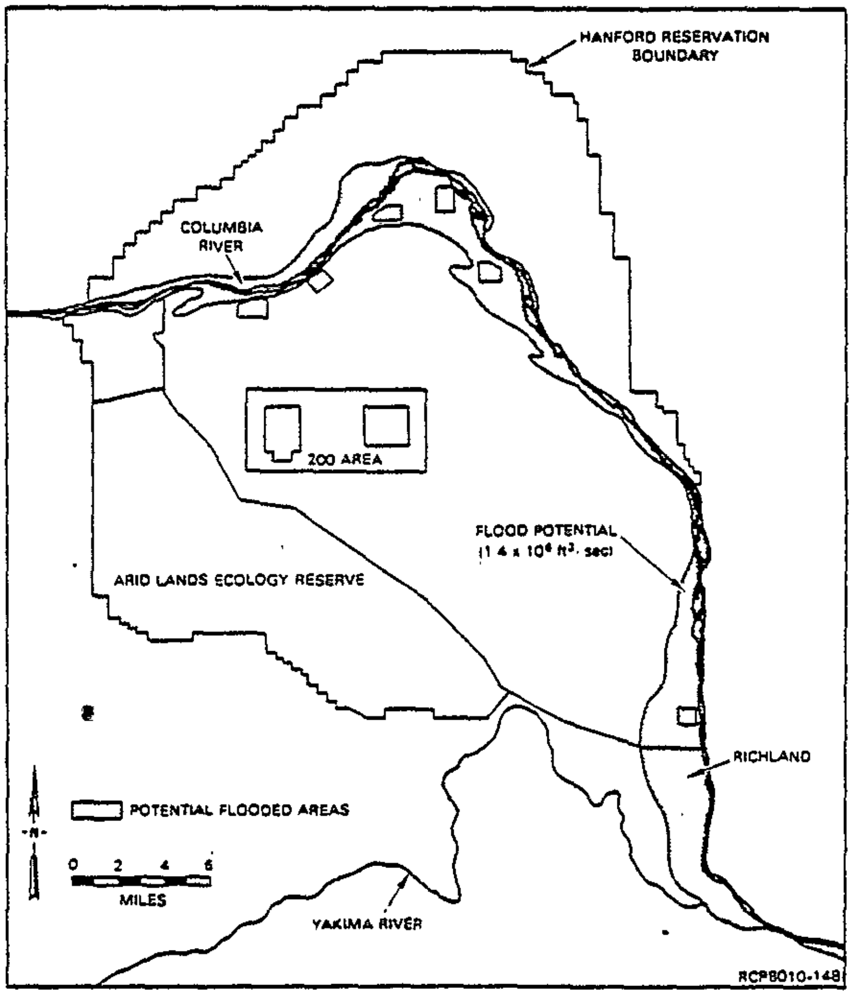

FIGURE 4. Potential Flooded Area in Event of Postulated Probable, Maximum Flood for the Hanford Site.

4.3 SAFETY PROTECTION SYSTEMS

4.3.1 Piping

All new process piping for 244-S and 244-A was designed to safely transport radioactive alkaline waste streams. Piping was encased but not heat traced or insulated. The encasements are equipped with leak-detection apparatus and draining capabilities. Provisions were incorporated into the piping design to periodically pressure test the primary and encasement piping. All process piping shall be designed in accordance with the American National Standards Institute (ANSI) B-31.1[16] to withstand a maximum pressure of 275 psig at 200°F and 100 psig saturated steam purging. All new process piping was designed to freely drain toward 244-S and 244-A with a minimum average slope of 0.25%. Encasements slope toward and drain into the DCRT pump pit.

Incoming heat-traced and insulated process lines from salt well systems were provided to the primary tanks of 244-BX, 244-TX, 244-U, 244-CR, and 241-AN-101. They extend to a tie-in point with the salt well system pumpout lines. Lines were provided from the 241-A, AX, AY, AZ condensate-producing ventilation system to the 241-AN-101 tank.

An encased pumpout line was provided from the DCRT pump pit to a tie-in point with existing waste transfer systems servicing concentration and storage facilities. For the 241-AN-101 tank, three encased lines were required. Any special pressure testing capability present on the existing salt well system piping was retained.

4.3.2 Structural

Salt well waste receiver facilities comprise a primary tank surrounded by a secondary containment vessel (tank vault) with access ports for pumps, instrumentation, and ventilation piping on top of the tank. The primary tank is located within the tank vault, separated by an annular space. The primary tank contains the aqueous radioactive waste.

The bottom of the tank vault is sloped to a sump for leak collection and detection. The tank vault is designed to contain any leakage from failure of the primary tank.

4.3.3 Ventilation

Ventilation equipment and associated instrument controls were designed to supply and exhaust filtered air from the vault and pit areas and to maintain the primary tank under a negative pressure of 1 to 4 inches water gauge. Radiation monitoring of the annulus exhaust air provides early detection of leakage into the annulus. Radioactive particulate emissions are maintained below the uncontrolled area concentration guides of DOE MC 0524[3] by treatment of exhaust air via two HEPA filters, in series. An off-gas heater prior to the filters reduces the relative humidity to less than 85% to prevent filter damage from moisture. The gases and vapors are sampled and monitored for radioactivity prior to release to the atmosphere. Air flow measurements and in-place testing of HEPA filters are provided. Equipment and ductwork containing unfiltered air from the ventilation system are contained in a concrete filter pit which drains to the primary tank.

4.3.4 Instrumentation

All 244-S and 244-A instrumentation provides signal conditioning or amplification for transmission to the 242-S/242-A evaporator control room. The primary tank is monitored with liquid level, specific gravity and temperature measuring instrumentation. In the annular space, a liquid level measuring device is installed to detect leaks from the primary tank. All pits and encasements have failsafe conductivity electrodes for leak detection.

Air samplers, airflow measuring devices, and radiation monitors are installed on the ventilation systems to measure and monitor radioactive releases to the atmosphere. Abnormal conditions such as leaks, high radiation levels, and high liquid levels will activate alarms.

Locally mounted instrumentation components are housed in a suitable weatherproof structure located at or near the DCRT. All alarms and controls integral to the operability and safety of the DCRT are mounted in 242-S/242-A evaporator control room.

Locally mounted instrumentation is provided at 244-BX, 244-TX, 244-U, 244-CR and 241-AN-101 to measure liquid levels, temperature, and specific gravity of the receiver tanks. Leak detection instrumentation is provided in the pump pits, pipe encasements, and tank vaults. Air samplers, air-flow measurement and radiation monitors are also installed on ventilation exhaust systems. Protection against receiver tank overflows is provided by a system of interlocks between the salt well system jet pumps, the Z Plant pump and receiver vessel liquid level instrumentation. Dilution water flow and flow control instruments are provided on the receiver tank pumps. Abnormal conditions such as leaks, high liquid levels, and high radiation air samples will activate local alarms and alarms at continuously occupied facilities.

4.3.5 Radiological

- Shielding. Personnel radiation exposure based on transfers/storage of wastes containing up to 6 Ci/gal ^{137}Cs will be reduced to <0.5 mR/hr for 244-S, 244-A, and 241-AN-101 by means of earth cover over the encased piping and concrete cover blocks over the vaults and pits. For 244-BX, 244-CR, and 244-TX, earth cover over piping and concrete blocks over the vaults and pits will reduce personnel exposure to <0.5 mR/hr, based on storage/transfer of waste concentrations up to 2 Ci/gal ^{137}Cs.
- Radiation Alarms. Radiation monitors with alarms are installed on the vault annulus ventilation exhaust on all facilities except the 244-CR vault. Radiation monitors with alarms are provided on all ventilation exhaust stacks on all of the facilities. Detection of radioactive particulates above a pre-set radiation level will activate local alarms and alarms at continuously occupied facilities.

4.4 CLASSIFICATION OF STRUCTURES, COMPONENTS, AND SYSTEMS

Quality related activities for all contractors involved in the design, construction, and testing of the new facilities were formulated and executed to assure that the design, construction, and testing were accomplished in a manner such that all components perform as required for safe and reliable process operation.

Three levels have been established for classifying structures and components according to the degree of quality assurance required by safety considerations for system design.(17)

Components in 244-S and 244-A are classified as follows:

- Level I - Tank structures (including primary tank and tank vault) pump pit, filter pit (including embedded piping and caissons), process pipe encasements, and instrumentation for radiation leak detection.
- Level II - Encased piping, ventilation system components (excluding instrumentation), tank riser, instrumentation (including electrical interlocks), pumps, remote pit jumpers, and electrical equipment.
- Level III - Raw water/steam/compressed air piping and components, and civil groundwork.

Components in 244-BX, 244-TX, 244-U, 244-CR, and 241-AN-101 are classified as follows:

- Level I - All tank structures (primary and secondary), all primary tank risers, all direct-buried process pipe, all leak detection components, all tank ventilation components, all pipe encasements, and all pump pit structures.
- Level II - All tank vault risers, all pumps, instrumentation (except for leak detection), controls, jumpers and process pipe in pits, and all encased process pipe.
- Level III - All other components.

4.4.1 Codes and Standards

Design and construction of facilities provided by Projects B-135 and B-180 were in accordance with the following regulations, code, and standards:

- DOE MC 6101, "Administration of the Construction Program"
- DOE MC 6301 Appendix, "General Design Criteria"
- DOE MC 0511, "Radioactive Waste Management"
- DOE MC 0550, "Operational Safety Standards"
- ANSI B-31.1, "Power Piping"
- HWS-5783, "Specification for Jumper fabrication.
- RHO-MA-150, "Quality Assurance Manual"
- ASME Pressure Vessel Code, Section VIII, Division 2, Appendix 4.
- DOE MC-0524, "Standards for Radiation Protection"

In addition to the above standards, applicable Hanford Plant Standards, Occupational Safety and Health Act Standards, and the "national concensus" codes and standards as developed by such organizations as the American Society of Mechanical Engineers, American Concrete Institute, American National Standards Institute, and the Institute of Electrical and Electronic Engineers were used. The latest edition of all codes and standards was used.

4.4.2 Maintenance and Design

Normal maintenance requirements were given consideration in the design of these facilities. Process piping was designed for periodic hydrostatic pressure testing. Encasements and encasement drains were designed for periodic leak checking. HEPA filter systems were designed for remote maintenance or replacement and for confinement of radioactive contamination and minimum personnel radiation exposure during such activity. Based on the planned services to be provided by each facility they were designed for the following minimum useful lives:

244-A, 244-S	20 years
244-BX, 244-CR, 244-U	5 years (tanks 10 years)
244-TX,	10 years
101-AN	50 years

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5.0 FACILITY DESIGN

5.1 SUMMARY DESCRIPTION

To implement Rockwell's commitment to discontinue the use of single-shell tanks for liquid waste storage after CY 1980, four DCRT (244-S, 244-TX, 244-U in 200 West Area and 244-BX in 200 East Area) were constructed as salt well waste receiver facilities. In addition, tanks CR-003 (244-CR vault) and 241-AN-101 in the 200 East Area will be used to provide double-containment storage for salt well systems wastes. The 244-A lift station in 200 East Area will be used in waste collection and transfer operations, but not as a primary salt well waste receiver.

5.2 PROCESS FACILITIES

5.2.1 Double Containment Receiver Tanks

As shown in Figure 5, 244-S is fabricated of reinforced concrete and consists of a vertical cylindrical tank vault surrounding a 20,000-gallon capacity primary tank, a pump pit, and a filter pit. Components for mixing steam and water for backflushing the pump and for decontamination are located in a flush pit next to 244-S.

The tank vault is 20 feet ID by 22-1/2 feet OD to a height of 21 feet 3 inches. The tank vault section is separated from the pump pit above by a 12-inch-thick concrete slab. The slab is perforated to permit piping and personnel access.

The pump pit area is cylindrical to a height of 12 feet 3 inches. The upper 10-foot portion of the pump pit is square in shape, 20 by 20 feet, surmounted by 2-foot-thick reinforced concrete cover blocks. The cylindrical sections of 244-S are lined with 1/4-inch-thick carbon steel to the bottom of the pump pit slab. The bottom slab and sump are lined similarly. The tank vault is equipped with a sump, which is fabricated of two pieces of 24-inch-diameter, Schedule 40, carbon steel pipe, located on 19-inch centers and 2 feet deep.

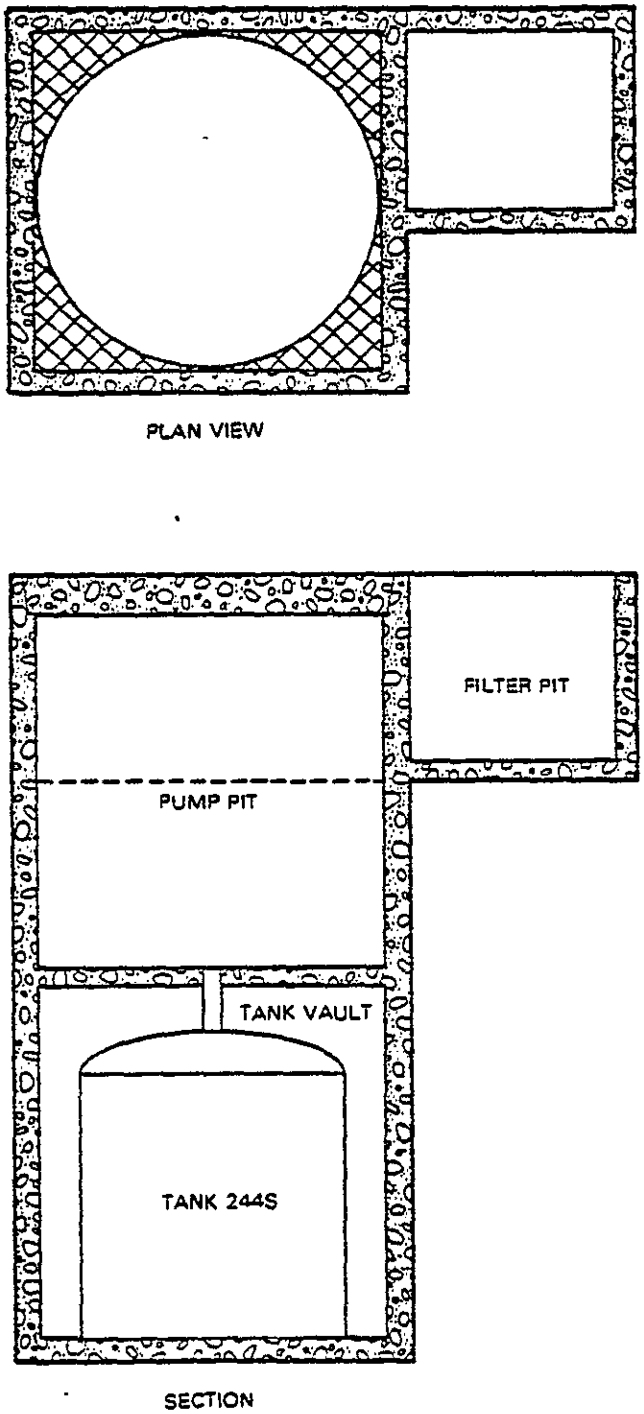

FIGURE 5. 244-S.

A filter pit, 11 feet square and 11 feet deep with 1-foot-thick reinforced concrete walls, is located adjacent to the upper portion of the pump pit. The filter pit is covered with a 3/8-inch steel plate. The filter pit is plumbed to drain to the 244-S receiver tank.

The receiver tank is equipped with a waste transfer pump and with instrumentation for measurement of specific gravity, weight factor, and temperature with readout in the 244-S-271 instrument shelter.

The receiver tank is also equipped with the following 3-inch piping:

- drains for the pump pit and filter pit
- two process nozzles for line drainback
- two spare nozzles, one of which will serve as the sample access.

A 4-inch ventilation line extends from the primary tank to the filter pit. The 244-A lift station, constructed in 1975, is of similar design.

The 244-BX, 244-TX, and the 244-U receiver tanks are horizontal, cylindrical vessels, 12-foot-OD and 35 feet long. The tanks are fabricated of carbon steel and painted on the exterior. The following number and size of risers are provided for each tank: one 24-inch, three 12-inch, one 6-inch, four 4-inch, seven 3-inch, and thirteen 2-inch. Each tank is equipped with a waste transfer pump and instrumentation for measurement of specific gravity, weight factor, and temperature with readout at local instrument shelters.

As shown in Figure 6, the vaults are fabricated of reinforced concrete and rectangular in shape. Each consists of tank vault, pump pit, and filter pit sections. The top of the vault is closed with cover blocks which allow access to the pump and filter pits. A horizontal, cylindrical, 25,000-gallon-capacity tank is located in the tank vault. The tank vaults are identical except that 244-TX is lined on the floor and walls to a height of 5 feet with 1/4-inch-thick carbon steel. Above 5 feet, the walls are covered by a protective paint (Amercoat). The floor and wall surfaces of the 244-BX and 244-U vaults are covered by protective paint (Amercoat).

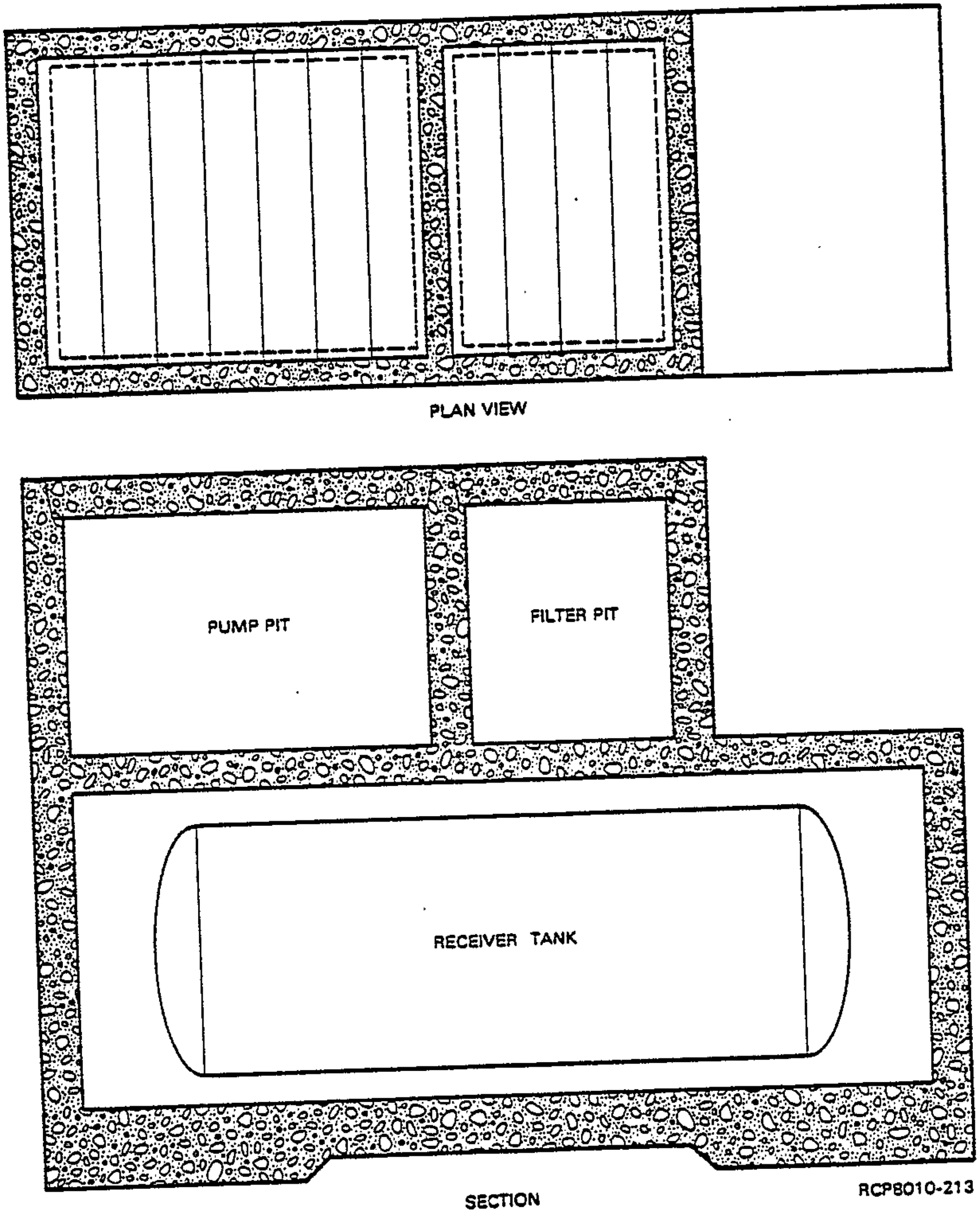

FIGURE 6. 244-BX, 244-TX, and 244-U.

The tank vaults are 16 by 44 by 16 feet high and are covered with a 3-foot-thick slab. The slab is perforated to permit piping and personnel access. The pump pits are 17 by 19 feet, and the height of each varies. To the top of the cover blocks, the pump pit height is 11 feet 6 inches for 244-BX, 9 feet 11-3/8 inches for 244-U, and 16 feet 1-1/4 inches for 244-TX. The filter pits are 11 by 17 feet and the height of each varies; the heights of the filter pits are the same heights as the pump pits. The cover blocks are reinforced concrete and are 2 feet thick.

The tank vaults are equipped with a sump, 6 feet 7 inches by 2 feet by 1 foot deep. The filter pits are plumbed to drain to the 25,000-gallon receiver tank.

5.2.2 244-CR Vault

The 244-CR vault was built in 1952. It is a reinforced concrete structure that houses two 40,000-gallon tanks (CR-011 and CR-001) and two 15,000-gallon tanks (CR-002 and CR-003). The CR-003 tank is used as a salt well waste receiver for the C Farm salt wells. As shown in Figure 7, the two large tank vaults are each 22 by 26 by 29 feet high. Each tank vault is covered over with a 2-foot-thick concrete slab that is perforated to permit piping and personnel access to the tank vault below. The area above each of the large tank vaults is 22 by 26 by 22 feet to the top of the cover blocks. The two smaller tank vaults are each 16 by 20 by 19 feet high.

All of the dividing walls, side walls, slabs, and cover blocks of the 244-CR vault are of 2-foot-thick concrete. Each tank vault is equipped with a sump, 2 by 3 by 1 foot deep.

The CR-003 tank is equipped with a waste transfer pump and with instrumentation for measuring specific gravity, weight factor and temperature.

5.2.3 Tank 241-AN-101

Tank 241-AN-101 is used as a salt well waste DCRT for the A and AX Tank Farms and for condensates from the 241-A, AX, AY, and AZ exhaust ventilation system. This tank consists of a 1,000,000-gallon steel tank within a steel tank enclosed within a reinforced concrete shell. This

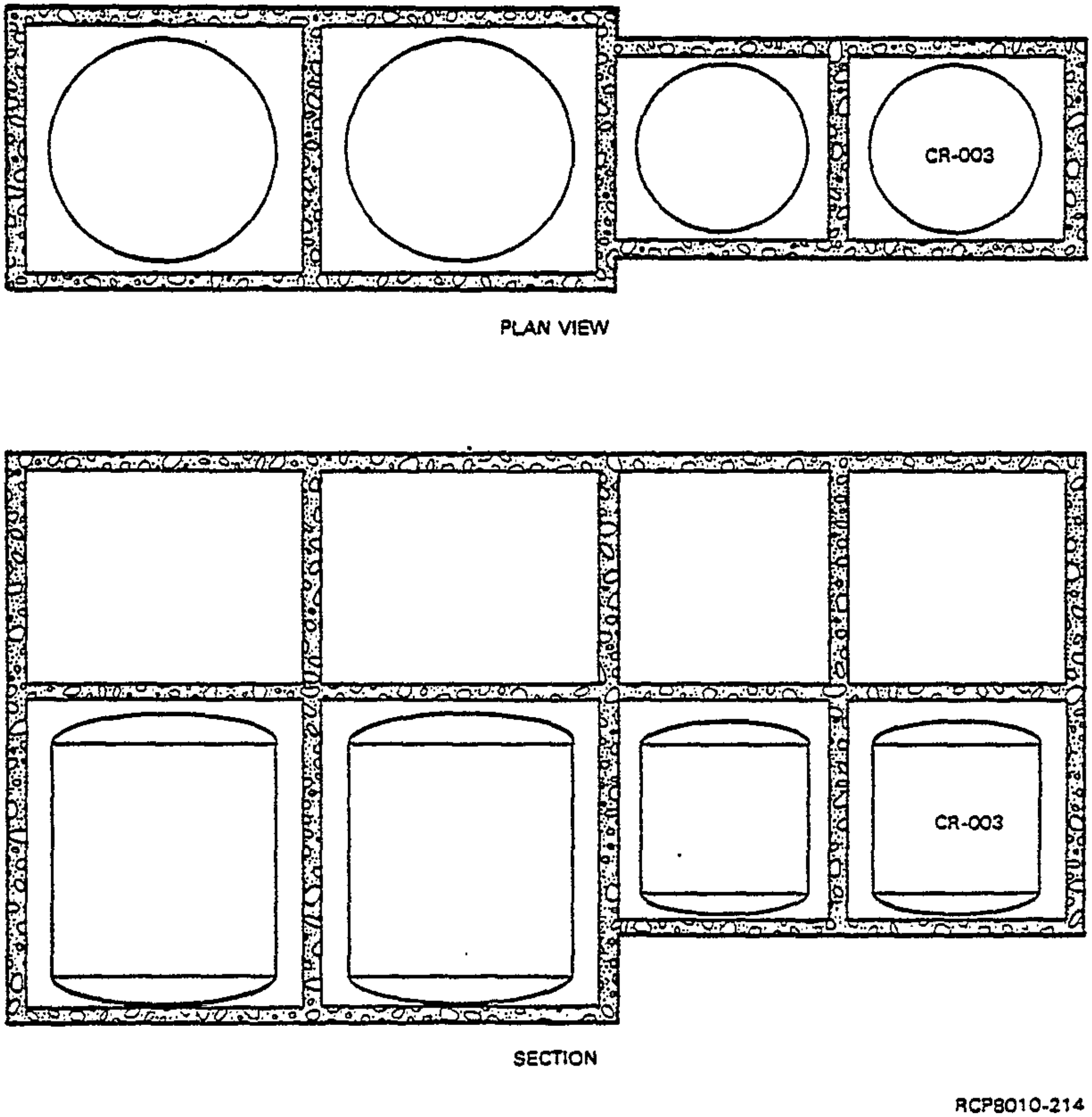

FIGURE 7. 244-CR Vault Section and Plan View.

tank (Figure 8) is built such that it has a 2.5-foot annulus between the primary and secondary tank walls. The bottom of the primary tank, which contains the stored wastes, is separated from the secondary tank by insulating concrete. The concrete is slotted to allow air to pass under the main tank. The annulus and its exhaust system provide several vital needs of radioactive waste storage tanks. The annulus provides an early warning leak detection system (radiation monitoring of exhaust air) and a secondary leak barrier by containing any leakage from the primary tank. It also provides a temperature buffer to prevent thermal stress in the concrete shell. A grid pattern in the concrete base (outer) pad is connected to a leak detection pit which is equipped with temperature and radiation monitors, and instrumentation to measure pit contents. The tank dome is reinforced concrete within a steel liner. There are dome penetrations for pumps, sludge and liquid level gauge observation ports, and temperature measuring devices. Other equipment associated with this tank includes pumps, piping, equipment pits, and leak detection probes in the annulus.

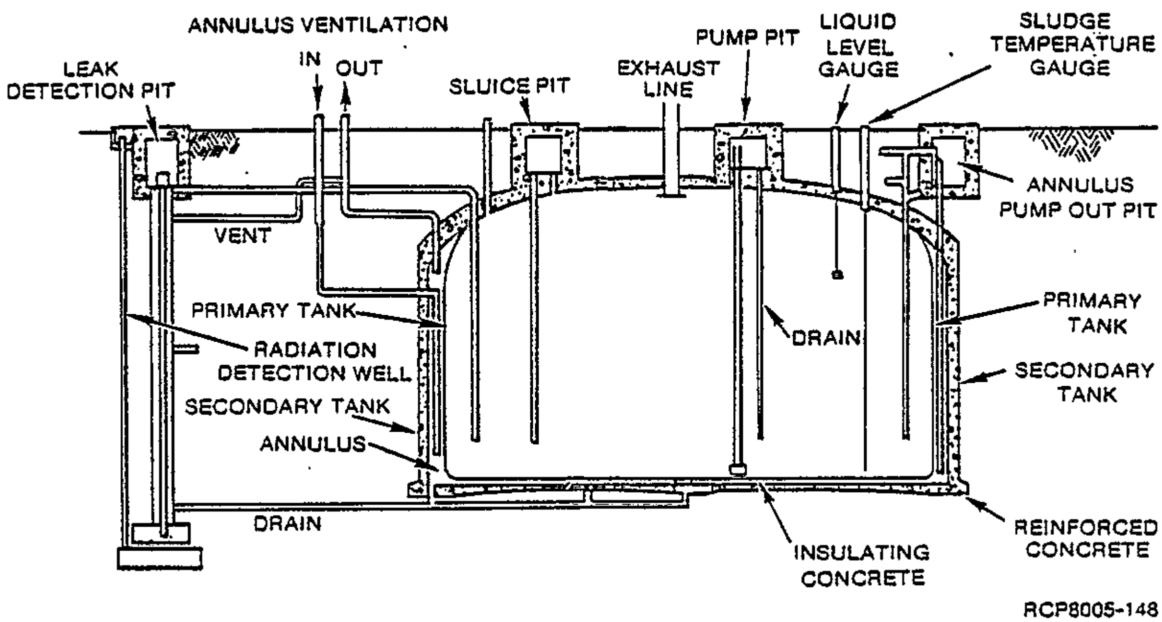

FIGURE 8. Double-Shell Waste Storage Tank.

Two new receiver pits were provided; one for handling salt well waste, the other for handling condensates. The pits are constructed of reinforced concrete. The side walls are 1 foot thick and the concrete cover blocks are 1 foot 8 inches thick. Each pit is 6 feet square and from 6 to 10 feet high to the top of the cover blocks, internally. Each pit is plumbed to drain to the 241-AN-101 tank.

5.3 SUPPORT AND UTILITY SYSTEMS

5.3.1 Ventilation

The ventilation systems (Figure 9) for the 244-A and 244-S DCRT are identical. The ventilation systems for the 244-BX, 244-TX, and 244-U facilities are similar to that of 244-S. The ventilation system serving the 241-AN-101 tank has been discussed in previous safety documentation.[18]

At 244-A and 244-S, the receiver tank, the pump and filter pits, and the tank vault annulus are vented via one ventilation exhaust system. Outside air @ 100 ft^3/min is supplied to the vault annulus after passing through an electrical heater, a roughing filter, and a single stage HEPA filter. A centrifugal type, 1-horsepower, electrically powered fan, (165 ft^3 min capacity) exhausts air from the facility at ~125 ft^3/min via an electrical heater and one of two parallel systems containing a roughing filter, and two stages of HEPA filtration. Exhaust air is sampled and monitored for radioactive particulate content prior to discharge to atmosphere via the 6-inch diameter, 16-gauge galvanized steel, 11-foot-tall stack. The supply air electrical heater is rated at 6800 Btu/hr; the exhaust air heater at 8530 Btu/hr.

All of the equipment in the exhaust air ventilation system up to the fan is installed in the filter pit. The fan and the stack are located outside of the filter pit, near the instrument enclosure. Filters are installed in jumpers with Purex-type remote connectors. Remote maintenance/replacement is thus possible.

At 244-BX, 244-TX, and 244-U the volume of supply air is 125 ft^3/min and exhaust is provided by single 250 ft^3/min fans. Three filter jumpers, each containing a roughing filter and two stages of HEPA filters, with a capacity of 125 ft^3/min, are installed in the filter pit. Two of the filter jumpers are normally "on-line" with backup capability provided by the installed spare.

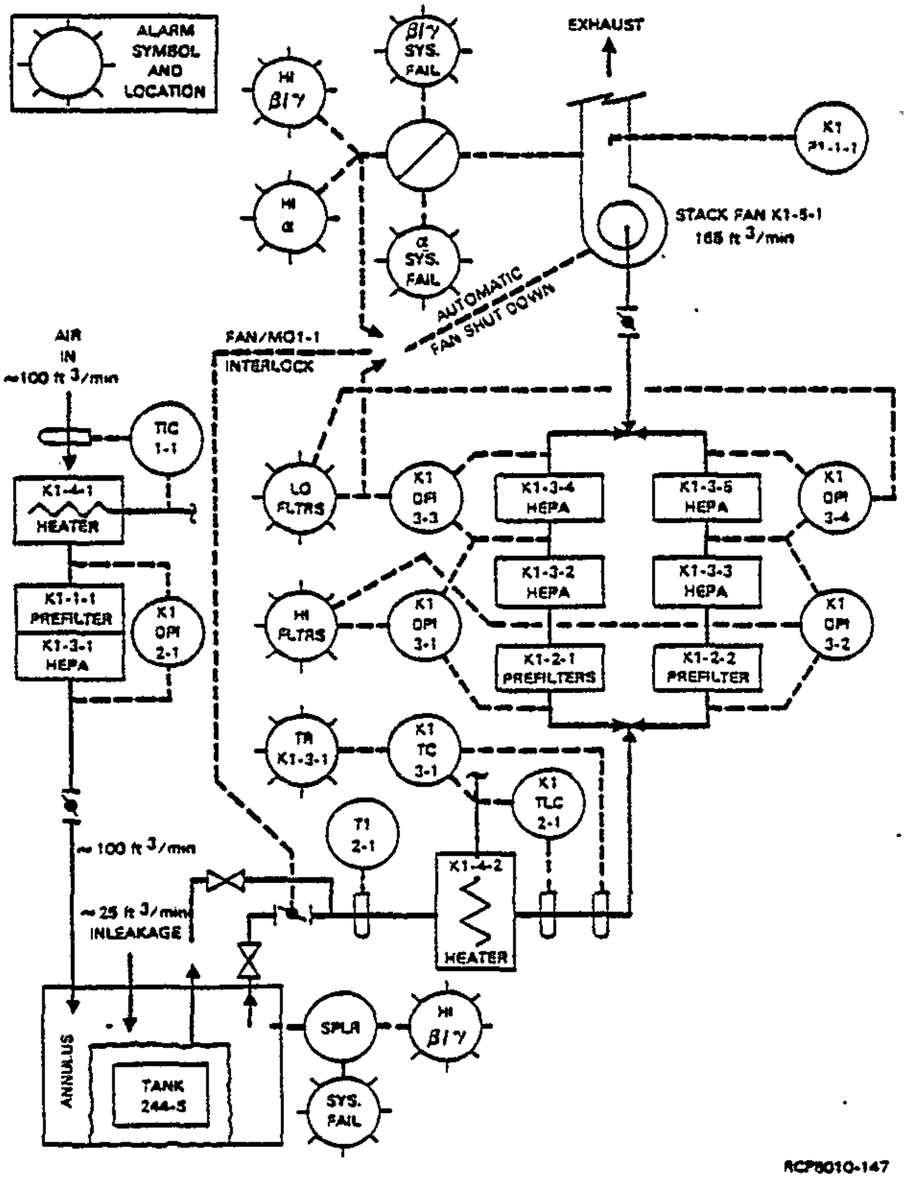

FIGURE 9. 244-S Ventilation Schematic.

At 244-CR, a 30-inch diameter inlet header supplies filtered air, via subheaders, to the pump pits and to the four vault sections containing the CR-001, CR-011, CR-002, and CR-003 tanks. Exhaust air from the tanks, pump pits and the vault areas is routed to the inlet plenum of the exhaust filters. Two exhaust fans (one operating, one in standby), each rated at 4200 ft^3/min and 10-inches W. G. provide the motive power for supply and exhaust air. Exhaust air is filtered via two stages of HEPA filtration, sampled and monitored for radioactive particulate content prior to discharge to atmosphere via the 15-inch-diameter, 50-foot-tall, metal stack. Backup filtration of exhaust air is not provided.

An instrument enclosure, adjacent to the filter pit (244-A, 244-BX, 244-S, 244-TX, 244-U) provides a shelter for transmitters and other locally mounted process and ventilation control instruments. These enclosures are prefabricated metal buildings, 8 by 12 by 9 feet high. They are ventilated by power roof ventilators (300 ft^3/min, 1/15 hp), which are equipped with birdscreens and a backdraft dampers. The 244-CR instruments are housed in the 271-CR building; 241-AN-101 instruments are in 241-AN-271.

Safety considerations and controls on the ventilation systems provide dampers and valves for regulation/isolation, measurement of differential pressure across the filters, continuous radioactive particulate monitoring and record sampling of exhaust air, and continuous flow measurement of exhaust air.

At 244-S and 244-A, high differential pressures (4 inches W. G.) across the roughing filter and the first of two HEPA filters in each bank sounds an alarm in 242-S/242-A building control rooms to note that action is required. Low differential pressures across the final HEPA filter in each filter bank automatically shuts down the exhaust fan and sounds an alarm. The exhaust stacks are equipped with continuous flow recorders and continuous air samplers. High activities detected by the air samplers and/or loss of sampler functions will shut down the exhaust fan and sound an alarm. Shutdown of an exhauster heater also sounds an alarm. All alarms for 244-S are located on Panel G in the control room of 242-S; (all alarms for 244-A are located in the control room of 242-A).

Provisions have been made to allow in-place testing of filters by introducing known particulates into the vault annulus with the inlet air stream and measurement of their removal efficiency.

The ventilation controls for 244-BX, 244-TX, and 244-U, are the same as discussed previously for 244-S/244-A. Alarms sound in occupied areas; i.e., for 244-BX, alarm panels are located in 241-BY-254 building, and annunciation is in 242-A building. For 244-TX, alarm panels are located in 242-T building and annunciation is in 242-S building; and for 244-U, alarms are located in 241-U building and annunciation is in 242-S building.

The 244-CR vault control room (271-CR) houses the alarm panel for the CR vault operations, including the ventilation system. Annunciation is in the 244-AR vault control room.

5.3.2 Electrical

Electrical power is supplied via existing lines serving the tank farms in 200 East and 200 West Areas. No emergency power is available to the facilities. Operations will be suspended during a loss of normal power.

5.3.3 Compressed Air

Compressed air is provided to the facilities to operate instrumentation by either a small local compressor or by piping instrument air from the nearest existing source in the tank farms. No emergency instrument air is available.

5.3.4 Steam and Water Supply and Distribution

Steam and raw water are obtained from existing supply lines in the tank farms. No emergency water or steam is needed; however, emergency water can be supplied from a tank truck.

5.3.5 Safety Communications and Alarms

In addition to the ventilation system instrument alarms, process system alarms (e.g., high liquid level, temperature, leak detection) annunciate locally and at general annunciator panel board at a continuously manned facility. An alarm indicates trouble. To find the trouble, the operator goes to the alarm panel which pinpoints the problem.

The location of the local and general annunciator alarms are listed below:

Facility	Location Annunciator	Alarm Panel
244-S	242-S	241-S-271
244-A	242-A	241-A-271
244-BX	242-A	241-BY-254
244-TX	242-S	242-T
244-U	242-S	241-U-271
244-CR	244-AR	271-CR
101-AN	242-A	241-AN-271

5.3.6 Fire Protection

Fire detectors, which will alarm at the 242-S building, are provided in the instrument shelters at 244-S, 244-TX and 244-U. Fire detectors, provided in the 244-BX instrument shelter and in the 271-CR building, will alarm in the 242-A building and at the 200 Area's fire station (609-A building). The fire detector in the 241-AN-271 instrument shelter (101-AN)[18] will alarm in the 272-AW building and at the 200 Area's fire station. Fire extinguishers and manually operated fire alarms are located near each facility.

5.3.7 Maintenance

Piping and equipment are designed for remote handling in the pump pits and in the filter pits.

6.0 PROCESS SYSTEMS

The salt well waste receiver facilities are provided to collect the effluents pumped from the salt well systems located in single-shell tanks. The salt well systems and the receivers (DCRT) that provide storage are:

	Salt Well System	DCRT
1.	241-T, TX, and TY	244-TX
2.	241-B, BX, and BY	244-BX
3.	241-U	244-U
4.	241-C	244-CR
5.	241-A, and AX	241-AN-101
6.	241-S and SX	244-S

In addition, 244-TX will receive neutralized wastes from Z plant; 241-AN-101 will receive condensates from the 241-A, AX, AY, AZ Tank Farms exhaust ventilation system; and 244-S will receive wastes from T and U plants, from the 222-S laboratory and may also receive wastes transferred from 244-TX and from the 204-S customer unloading facility until the new 204-AR facility is in operation. The 244-A and 244-S receiver tanks will also provide storage for line holdup that gravity drains from the cross-site line following waste transfers between the 200 East and 200 West Areas.

6.1 PROCESS DESCRIPTION

The process description and schematic flow diagram are presented for 244-S in Figure 10. These are typical for the six salt well system waste receivers and the 244-A tank.

The S and SX salt wells pump to 244-S DCRT. When the volume reaches a prescribed level in the tank, it will be pumped to tank 102-SY, a double-shelled tank. When tank 102-SY reaches the prescribed volume, it will be transferred to the designated waste tank in 200 East Area through the 244-S pump pit piping. Figure 10 shows the basic elements of this installation. The tank 102-SY cross-site routing goes through the 244-S

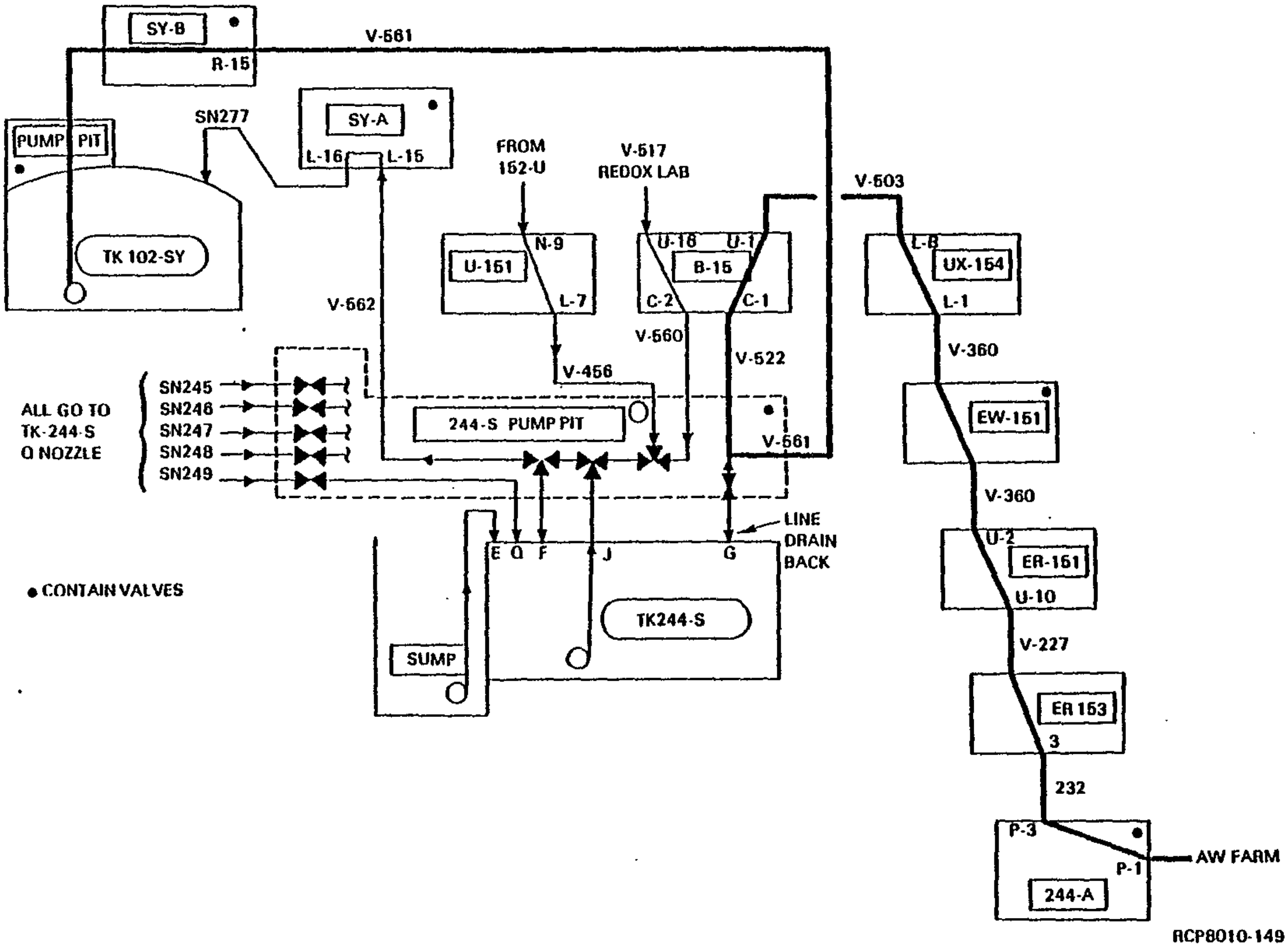

FIGURE 10. 102-SY Cross-Site Transfer Route and 244-S DCRT.

pump pit piping, but not into the 244-S primary tank. Wastes collected in the 244-TX receiver tank will also be transferred to the 102-SY tank via the 244-S pump pit piping. Wastes collected in 244-U will be transferred to 102-SY. Wastes collected in the 244-BX, 244-CR, 241-AN-101 and 244-A tanks will be transferred to one of the 241-AW double-shell tanks.

A leak in the flush pit will drain to the pump pit. The pump and filter pits drain to 244-S. Each of the three drains have a liquid seal trap. A primary tank leak in 244-S would drain to the 80-gallon annulus sump. The sump can be pumped to the primary tank in 244-S when the jumper is in place.

The precipitation of solids from the accumulated liquor during the transfer from the DCRT to concentration or storage will be prevented by water dilution. The water will be injected into the transfer pump suction at a controlled rate.

6.2 PROCESS SUPPORT SYSTEMS

6.2.1 Double Containment

All of the salt well waste DCRT and the 244-A lift station provide double containment for storage of waste liquids, which is a minimum of two physical barriers between the radioactive material and the environment.

6.2.2 Leak Detection

Leak detectors are installed in all of the DCRT sumps and the new pump pits. The pump pit leak detectors are interlocked with the primary pumps to shut down in the event of a leak. Each process line is provided with a test riser to detect contamination leakage in the pipe encasements. Leak detectors are also installed in all of the new filter pits and flush pits.

The atmospheres of the DCRT annuli are continuously monitored for beta-gamma radiation for (241-AN-101, 244-A, 244-S, 244-BX, 244-TX and 244-U). High radiation indicates the presence of mixed fission products which could mean the accumulation of liquid in the DCRT sump from a leak in the system. High radiation or monitor failure shuts down the salt well pumps in the corresponding system.

6.2.3 Neutron Detection

Three neutron detectors are installed beneath the 244-TX tank to detect retention and buildup of plutonium resulting from transfer of Z Plant waste. The capability to install or use portable neutron detectors in 244-S is also provided. The detection of neutrons above a predetermined level in 244-TX or neutron monitor failure shuts down the Z Plant waste transfer pump.

6.2.4 Receiver Tank Sluicing

In 244-TX, rotating spray nozzles are installed inside the tank to aid in tank flushing. Hose bibs are provided so that raw water can be hooked up to the nozzles. Also, the tank is equipped with 11 sluice jets and piping from a pump-agitator to provide solids resuspension.

6.2.5 Systems Flushing

To minimize the precipitation of solids from the liquor in the piping systems, the capability of water dilution is provided for all of the new receiver tanks. Water is added to the primary tank pump inlet for entry into the systems.

7.0 WASTE CONFINEMENT AND MANAGEMENT

7.1 GASEOUS

Ventilation exhaust air from the salt well waste receiver facilities is filtered via two stages of HEPA filtration and continuously sampled and monitored for radioactive particulate content prior to release to atmosphere via the facilities' respective stacks (Table 1).

TABLE 1. Ventilation Exhaust Stacks.

Facility	Exhaust Stack	Remote Monitor Alarm Location
244-A	296-A-25	242-A
241-AN-101	296-A-29	242-A
244-BX	296-A-28	242-A
244-CR	296-C-5	244-AR
244-S	296-S-22	242-S
244-TX	296-T-18	242-S
244-U	296-U-11	242-S

If radioactivity is detected in the stack discharge above a preset level (see Operations Safety Requirement 11.2.2), local and remote alarms alert operations and radiation monitoring personnel, who investigate to determine the cause and initiate remedial action.

Exhaust systems are designed, constructed, and maintained to remove radioactive particulates from gaseous effluents to meet specified concentration guides.[3,19]

7.2 LIQUID

All liquid wastes generated by operation of the salt well waste receiver facilities will be routed to underground waste storage tanks.

7.3 SOLID

Solid, radioactively contaminated wastes generated during operation and maintenance of the salt well waste receiver facilities (failed equipment, parts, plastics, rags, etc.) are packaged, handled, stored and disposed of in accordance with specified requirements.[4]

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8.0 RADIATION PROTECTION

8.1 EXPOSURE CONSIDERATIONS

Compliance with Rockwell policy[20] requires that all operations and planning functions be conducted in a manner that will assure exposures of employees and the population to radioactive and/or nonradioactive toxic materials are maintained at a level as low as is reasonable achievable in accordance with established guidelines.[3,19] The Radiological Controls Manual[21] describes methods for controlling radiation exposures to employees and the public and provides guidelines for uniform and purposeful compliance with the above policy within Rockwell.

Interpretation of requirements stated in the Radiological Controls Manual[21] is the responsibility of the Radiological Protection Department. Implementation of the standards and controls is the joint responsibility of Radiation Monitoring and Tank Farm and Surveillance Operations personnel. Dose and dose rate determination, air sampling, air monitoring, contamination surveys, personnel surveys, and the overall radiation control plan[22] will be responsive to requirements of the Radiological Controls Manual,[21] the Radiation Monitoring Manual of Standard Practices,[23] and the applicable Radiation Work Procedures.[24]

8.2 SOURCES

Kilocurie quantities of mixed fission products (primarily ^{90}Sr and ^{137}Cs) will be present in wastes collected and transferred via the salt well waste receiver tanks. Kilogram quantities of transuranic radionuclides (primarily ^{239}Pu) will be collected and transferred via the 244-TX salt well waste receiver tank. The associated piping and waste transfer systems will contain curie quantities of mixed fission products and gram quantities of transuranics. Exhaust from the DCRT vapor space contains entrained microcurie quantities of mixed fission products and transuranics, which will be retained by the installed HEPA filtration system.

8.3 PROTECTION DESIGN FEATURES

The salt well waste receiver facilities and associated waste transfer systems were designed and constructed to provide earth, concrete, and steel shielding (e.g., concrete cover blocks for pump pits - concrete cover blocks or steel plate for HEPA filter cells) to reduce surface radiation exposure rates to as low as practical, but not to exceed 0.5 mR/hr.[25,26]

Two stages of HEPA filtration are provided on each system, with installed redundant backup capabilities on all systems except the 244-CR vault. Continuous air monitors with local and remote alarms and record air samplers are installed on the stack discharges. Samples are routinely submitted for laboratory analysis and reported in accordance with requirements of RHO-MA-139.[19]

8.4 ESTIMATED ONSITE DOSE ASSESSMENT

An onsite dose measurement program is in place and radiation exposure controls are provided to maintain personnel whole body exposures within prescribed limits[21,22] (≤300 mrem/7-day period, <1.25 rem/quarter, <3 rem/yr.[21]

8.5 HEALTH PHYSICS PROGRAM

Rockwell provides trained radiation monitors (Radiation Monitoring Group) and radiological engineers (Radiological Engineering Group) who develop and implement the Health Physics Program.[21,23,24] A qualified radiation monitor is available 24 hours a day to respond to tank farm radiation alarms and to provide other required radiation monitoring services.

Personnel who require routine or emergency access to the tank farms are trained and qualified as radiation workers.[23] Specifically authorized and qualified radiation workers are authorized to monitor themselves in radiation zones up to 100 mR/hr.[24] Survey instruments are routinely calibrated and serviced by Pacific Northwest Laboratory

8.6 ESTIMATED OFFSITE DOSE ASSESSMENT

Rockwell effluent and environmental monitoring requirements are provided in the Environmental Protection Standards Manual.[19] Exhaust systems are designed, constructed, and maintained to remove radioactive particulates from gaseous effluents to meet DOE MC 0524 concentration guides.[3] Similar operating facilities of this design meet these requirements. Environmental release of liquid effluents is not anticipated. The offsite radiation dose to the average individual from the entire Hanford Site operations for CY 1979 was estimated at 0.005 mrem/yr.[5] The incremental contribution to this offsite radiation dose resulting from normal operations of salt well waste receiver facilities would be unmeasureable.

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9.0 ACCIDENT SAFETY ANALYSIS

9.1 HAZARDS

The planned operation of the salt well waste receiver facilities was reviewed to identify potential hazards resulting from:

- breach of containment barriers
- failure of confinement barriers
- uncontrolled chemical reactions
- nuclear excursion
- extrinsic events (natural and man-made)
- radiological hazards
- industrial hazards.

A listing of identified generic hazards and postulated event sequences, consequences, and mitigating/preventive measures is shown in Tables 2 through 8.

9.2 ABNORMAL OCCURRENCES

Unwanted events which occur during the operation of these facilities may result in abnormal occurrences and/or accidents. Abnormal occurrences are defined as those event sequences resulting in injury to operating personnel, abnormal radiation exposure of operating personnel, contamination spreads within the facility proper, or the interruption of continuity of operations. Though minor releases to the immediate environs may be associated with the occurrences, little or no incremental risk is imposed on the offsite population over and above normal plant releases.

Each of the hazards identified in the tables may, with loss of control, generate an abnormal occurrence or an accident; however, equipment and controls, engineered safety systems, administrative controls, etc., were designed to prevent and/or mitigate the impact and effects of each identified hazard.

TABLE 2. Generic Hazard - Breach of Containment Barriers.

Hazard	Cause	Result	Mitigating/Preventive Measures
Vault breached	Load limit exceeded.	Extensive equipment damage with resultant program delays. If pump pit base breached, potential for tank breach/vault liner breach.	Vault design basis - most severe combination of following loads: • maximum density backfill • 40 lb/ft^2 live load • 6 inches water vacuum • safe shutdown earthquake (0.25 g) • thermal gradient produced by 250°F solution in tank.
	Dropped block/crane-loaded.	Same as above.	Crane and rigging inspected biennially, maximum load testing and third party inspection/certification. Operator trained in all aspects of crane operation.
	Temperature, chemical and/or radiation deteriorate concrete.	Weakened vault wall potential leak path to soil.	Concrete protected by carbon steel liner. Protective coating in pump pit walls, base, and blocks.
Tank leak	Tank fails due to external/internal pressure in excess of design basis.	Liquid waste leaks to vault annulus. No direct leak path without vault failure or loss of confinement.	Leak detection, collecting sump and pump provided. Tank designed for maximum specific gravity and volume of waste solution. Interlocks shut down transfer pump.
	Tank fails due to corrosion/thermal cycling.	Same as above.	Tank designed to minimum 10-year service life, including thermal cycling and solution composition concerns. (101-AN designed for 50 yr life)
Tank overfilled	Liquid level instrumentation failed and transfer procedures violated, resulting in tank overflow.	Liquid waste backup into pump pit via seal. Liquid entrained in exhaust vent potentially damaging exhaust filters.	Material transfer and surveillance procedures require tank inventory control. Tank instrumentation and seal loop conductivity probe provide redundant high liquid level alarms. Drain seal loop and re-establish overall detection.
Waste leak from jumper or connector	Line or seal or connector fails leaking waste solution to vault.	Liquid waste leaks to pump pit, drains to tank. No direct leak path without vault failure or loss of confinement.	Liquid waste leaks to vault annulus. No direct leak path without vault failure or loss of confinement.
Waste transfer line leak	Waste transfer line fails due to corrosion, thermal stress, etc.	Liquid waste leaks to pipe encasement. No direct leak path without second failure.	Encasement drain to pump pit. Conductivity probe detects leak, alarms and shuts down transfer pump.

TABLE 3. Generic Hazard - Confinement Barriers Fail, are Circumvented, or Compromised.

Hazard	Cause	Result	Mitigating/Preventive Measures
Failure of ventilation system (HEPA).	HEPA filters in dual series can be damaged by any of the following causes: fire, excessive air flow due to vessel pressurization or high fan vacuum, excessive differential pressure loading across inlet face of filter, process condensate collecting on the filters caused by shutdown or failure of electrical heater or structural failure of filter holder seal. As a result, the system becomes ~99.95% efficient for particles ~0.3 um.		
	Lowered efficiency limited to only one HEPA filter stage in the series.	Slight lowering of overall filtering efficiency. No offsite impact on environs.	The exhaust stream would still have one filter serving as a barrier. Filters would be tested per Reference 27 and replaced when necessary. The systems are designed to provide continuity of ventilation air throughout the tanks and annuli during equipment maintenance and filter changeout.
	Lowered efficiency because of damage to both HEPA filters in series.	The effluent continuous air monitor is set to alarm when the detected radiation in exhaust stack airstream is 10% above the continuous operating level being recorded. Offsite impact on the environs is very unlikely.	Stack radiation monitor and alarms must be functional for operation of ventilation systems. The damaged filters will be replaced. Fan interlock to shut off on stack CAM alarm, or failure of CAM.
	Improper temperature regulation of exhaust air stream or heater failure results in moisture deposited on filter.	A filter exposed to saturated air becomes wet and structurally weak.	Temperature controllers located in the air heaters of the HVAC system provide regulated air temperatures. The electric heaters must be functional for operation. Filters are DOP tested for efficiency and changed if required.
	Improper temperature regulaton of of exhaust air stream resulting in temperature rise of inlet air temperature above 230°F.	Excessive temperatures in the air stream will cause weakening of the filter gaskets and lead to filter failure.	Temperature controllers located in the air heaters of the HVAC system provide regulated air temperatures. The electric heaters must be functional for operation. Filters are DOP tested for efficiency and changed if required.
	Excessive particulate loading on exhaust filters.	If the pressure drop across the HEPA filter becomes excessive, the filter may fail. Equipment may become contaminated and radionuclides could be released to the environment.	Correct HEPA filter operation and required operation changes assured by procedure. In the event of ventilation system failure, transfer activities will cease. Damaged filters are replaced.

9 0 1 1 3 3 1 1 2 3 3

TABLE 3. Generic Hazard - Confinement Barriers Fail, are Circumvented, or Compromised (Continued).

Hazard	Cause	Result	Mitigating/Preventive Measures
Ventilation exhaust failure	Breakdown of equipment or loss of utilities and services.	Loss of negative differential on tank, vault, and pits. Potential small release to immediate vicinity as vault/tank breathes.	Tank and pits sealed from vault by water-filled seal loops. All transfers into, out of, or through vault will cease.
Loss of exhaust gas monitoring/sampling	Equipment failures or loss of utilities and services.	Loss of monitoring capability of gaseous effluent.	Effluent monitoring/sampling capability must be functional for operation. Transfers into, out of, or through vault will cease. Portable instrumentation may be installed or installed equipment repaired/replaced, depending on the nature of the failures.

TABLE 4. Generic Hazard - Uncontrolled Chemical Reactions.

Hazard	Cause	Result	Mitigating/Preventive Measures
Accumulation of hydrogen in tanks	Hydrogen gas is produced by the radiolytic decomposition of water present in radioactive waste and ignites. This event is considered not credible.	Assuming the combustion was sufficiently rapid to pressurize the tank, the severe pressurization of the tank and vent system could lead to a rupture of the HEPA filters and subsequent radiation release.	Tank ventilation system provides adequate air movement to ensure that hydrogen does not build up in tanks. In addition, sufficient time is available to provide for backup in the event the primary system is lost.
Explosion of nitrate compounds	Some generated wastes contain large amounts of sodium nitrate and, if combined in proper proportions with certain other materials, can react explosively. This event, however is not credible.	Detonation of nitrate compounds could rupture a tank and HEPA filters.	Several studies have been made to determine if salt cake or 'worst case' organic mixtures were detonable. These studies have shown that Hanford's solid wastes will not undergo an explosion.(28,29)
Acid waste routed to receiver tank	Failure to neutralize properly (pH 9) waste transferred to tanks. Could be caused by processing omission or error such as improper chemicals, or accidental siphoning or transferring of solution. First indication could be rapid generation of nitrogen oxides, visually apparent by dark brown color in vent system exhaust. Low pH would also be detected in analysis of waste tank samples.	This event would damage lines or seriously damage the tank. Lowering the pH will increase the corrosion rates of the tank and lines. Operating response will be to determine the pH of the solution in the tank and add caustic to adjust the pH to 9 or above.	All batches transferred from processing plants such as U Plant, T Plant and Z Plant or customer waste unloading facility are analyzed for pH, and double checked by supervisory personnel before a transfer can be made.

TABLE 5. Generic Hazard - Nuclear Excursion.

Hazard	Cause	Result	Mitigating/Preventive Measures
Nuclear criticality excursion	Sufficient fissile material accumulates in a tank to form a critical configuration.	The hypothesized criticality excursion would heat the tank contents, release gaseous fission products, and result in high radiation fields in the vicinity of the tank and vault.	All material to be transferred/stored must have known composition within the limits or be sampled, analyzed, and verified to be within compositional limits prior to transfer. In general, solution is to be $\leq$0.05 g plutonium/gal to assure safety. In addition, fissile material concentrations are specified and operational controls are such that no potential of criticality is possible from inadvertent buildup of fissile material. 244-TX equipped with pump-agitator and in-tank spray nozzles to assure mixing and transfer of solids. 244-TX is flushed after each transfer to 102-SY. Transfers from 234-5 Z Plant to 244-S are not made. Transfers of solids from 244-TX to 244-S are minimized. 244-TX is provided with in-place neutron monitoring. The 244-S tank is provided with dry wells to permit periodic monitoring for accumulation of plutonium.

TABLE 6. Generic Hazard - Extrinsic Events: Natural and Man-Made.

Hazard	Cause	Result	Mitigating/Preventive Measures
Seismic activity	Facilities subjected to a range of horizontal and vertical seismic accelerations.	Depending on the seismic event, consequences range from negligible to severe damage, including disruption of utilities, services, and impairment of confinement.	New underground facilities: designed for seismic load to 0.25 g horizontal and 0.17 g vertical ground acceleration. Site location characterized as low to moderate seismicity (Zone 2). Processes designed for safe shutdown earthquake.
High wind	Facilities subjected to high wind loading and associated debris.	Potential impact on utilities and services.	Facility design considerations, including loading associated with an 85 mph wind for above-ground auxiliary facilities
Tornado	Facilities subjected to high speed translational and rotational winds, coupled with rapid pressure fluctuation.	Depending on severity and path, consequences range from negligible to severe including loss of utilities, services and impairment of confinement.	Site location very low frequency of severe tornadoes. Process designed for safe shutdown.
Thunderstorm	Facilities subjected to thunderstorm activity.	Consequences include potential loss of utilities and services.	Facilities grounded for protection in event of lightning strike. Processes designed for safe shutdown resulting from loss of utilities.
Severe Cold	Facilities subjected to severe cold, significant snow loading, or ice.	Consequences include possible loss of utilities and services.	Relatively mild winters occur at site location, provisions for snow and ice (live) loading of 40 lb/ft^2. Critical instrumentation insulated and/or thermostatically heat traced. Emergency procedures specify additional requirements for mitigating utility failures in winter.
Aircraft crash	Aircraft impacts facilities.	Potential breach of containment, impairment of confinement, and interruption of utilities and services.	Site location is such that air traffic is light.
Loss of electricity	Power lost to incoming lines.	Loss of operation of instrumentation, pumps, ventilation exhaust units, heat tracing and lighting. No emergency electrical power is in place. "Breathing" of the tanks and vaults could result in release of minute amounts of contaminated air through pit cover blocks, should an extended outage occur.	Systems are designed to failsafe. Reference 30 outlines responsibilities for responding to this event. Transfer activities would be suspended.
Loss of steam	Steam lost due to header failure or powerhouse problems.	Inability to flush lines; only slight impact.	Since the impact is relatively slight, preventive or mitigating measures are not deemed necessary. 244-TX transfers would be suspended if total flushing capability lost.

TABLE 6. Generic Hazard - Extrinsic Events: Natural and Man-Made (Continued).

Hazard	Cause	Result	Mitigating/Preventive Measures
Loss of water	Loss of raw water, resulting from system failure due to system failure at power plant.	Inability to flush and clean plugged process slurry lines; only slight impact.	Water trucks are available which can be used to supply water for flushing. 244-TX transfers would be suspended if total flushing capability lost.
Loss of compressed air	Failure of compressor.	Loss of air for instrument operation and air purging.	Portable compressors can be obtained to supply system requirements. Systems designed to failsafe.

TABLE 7. General Hazard - Radiological Hazards to Operating Personnel.

Hazard	Cause	Result	Mitigating/Preventive Measures
Occupational personnel exposure	Breakdown in any one or combination of administrative controls stated in References 21 and 24. • Doses of penetrating radiation to whole body or radiosensitive organs of radiation workers shall not exceed 1.25 rem/quarter or 3.0 rem/year.	Potential individual or occupational radiation overexposure.	Administrative controls will be enforced. Violations will be investigated and reported as an unusual occurrence per Reference 31. Several design features to minimize the potential for personnel exposure include: • Constructing tanks in a concrete vault • Requiring earth cover over lines • Requiring encasement of all process lines
	Failure to make efforts to reduce worker exposures to amounts that are as low as practicable such as detailed planning of all work which involves radiation exposure potential to reduce the exposure time, to provide adequate shielding, and to preclude radionuclide intake.	Potential exposures are not as as low as practicable as discussed in Reference 3.	The Waste Management Program has adopted a Contamination and Exposure Plan (22) for tank farm operations-the goal is to provide a base from which to build safe and efficient radiological waste management practices.
	Breakdown in one or combination of administrative controls or procedures, particularly: • Operational limits prohibit entry of nonsurveillance or nondecontamination personnel into areas in which the removable contamination levels exceed 40,000 dpm/100 cm^2 alpha or 400,000 dpm/100 cm^2 beta-gamma per Reference 21. • Areas shall be posted as "surface contamination" when removable contamination exceeds 200 cpm/100 cm^2 beta-gamma. • Occupied surface contamination areas are surveyed each work day. • Area adjacent to surface contamination areas are surveyed once per week. • Areas which are remote from surface contamination areas but have radiological significance are surveyed bi-weekly. • Step-off pads between surface contamination areas and the clean areas are checked once per work shift. • Personnel are required to be surveyedfor contamination prior to leaving any radiation area.	Individual personnel contamination incident or spread of contamination to clean area.	Administrative Controls • Personnel working in or near radiation areas must follow regulations outlined in Reference 24. • Surveillance of radiation areas to minimize personnel contamination is outlined in Reference 23. • General requirements and contamination control guidelines for working in radiation areas are outlined in Reference 21. • Personnel working in radiation areas are required to wear appropriate protective equipment per Reference 31. Design features to minimize personnel exposure/contamination include: ventilation systems installed on each tank to maintain the internal space at a slight negative pressure, thereby ensuring containment of radioactive airborne particles.

TABLE 8. Generic Hazard - Industrial Hazards.

Hazard	Cause	Result	Mitigating/Preventive Measures
Maintenance activities			
Electrical	Maintenance on electrical systems.	Potential for personnel injuries.	Lockout and tag procedures, "buddy" system, protective apparel, and insulated tools.
Shop fabrication hazards	Falls, falling objects, noise, exposure to heat, and welding glare.	Potential for personnel injuries.	Posted safety rules, protective apparel, Rockwell Safety Program.
Pressurized lines	Exposure to high pressure fluids.	Potential for personnel injuries.	Pre-job safety plans, lockout and tag procedures, bleed-down provisions.
Surveillance	Trips, falls, sprains.	Potential for personnel injuries.	"Buddy" system, area worksite housekeeping, walkways and paths.
Vault/pit access	Confined spaces access, trips, falls, sprains.	Potential for personnel injuries.	Pre-job safety plans, application of "Work in Confined Spaces" safety standard as appropriate.
Fire	Packaged solid combustible wastes may ignite from spontaneous combustion or from external ignition source.	Potential facility/safety instrumentation damage depending on location (most likely would be for instrument shelter).	Good housekeeping procedures minimize combustibles. Waste is segregated in packaging and storage to prevent combining oxidents and combustibles. Strong acids not used.
	Electrical cable/switchgear fire.	Loss of power, potential facility/safety instrumentation damage depending on location.	Electrical systems designed to applicable codes; standards and regulations.

9.3 ACCIDENTS

An accident is defined as a credible situation which creates demand on the system beyond the possible capability of the process, equipment, or containment/confinement features, whether or not mitigated by operation of standby or engineered protection features. Potential accidents associated with operation of the salt well waste receiver facilities are analyzed and discussed.

Dose commitments resulting from the postulated accidents were calculated based on data from Reference 32, which used the ALLDOS computer program to generate unit release radiation dose factors for acute releases of radionuclides at ground level in the 200 Areas. Dose commitment factors for isotopes of most biological significance are shown in Table 9. The maximum individual is located 5.5 miles (8.8 km) southwest of the 200 Areas.

TABLE 9. Dose Commitment Factors.

Radionuclide	1 Year, rem/Ci			70 Years, rem/Ci		
	Whole Body	Bone	Lung	Whole Body	Bone	Lung
Maximum Individual						
^{90}Sr	7.8×10^{-3}	2.9×10^{-2}	2.4×10^{-2}	3.2×10^{-1}	1.2×10^{0}	5.7×10^{-2}
^{137}Cs	1.1×10^{-2}	1.1×10^{-2}	1.9×10^{-3}	2.3×10^{-2}	2.5×10^{-2}	8.1×10^{-3}
^{239}Pu	1.5×10^{-2}	3.5×10^{-1}	2.0×10^{0}	8.5×10^{-1}	1.8×10^{1}	5.1×10^{0}
Population						
^{90}Sr	1.6×10^{1}	5.8×10^{1}	2.4×10^{1}	6.2×10^{2}	2.3×10^{3}	5.7×10^{1}
^{137}Cs	2.9×10^{1}	3.0×10^{1}	5.0×10^{0}	6.1×10^{1}	6.7×10^{1}	2.1×10^{1}
^{239}Pu	1.5×10^{1}	3.6×10^{2}	2.0×10^{3}	8.5×10^{2}	1.8×10^{4}	5.1×10^{3}

9.3.1 Failure of Ventilation Filters

Accident Scenario. Failure of HEPA filters could occur as the result of moisture collecting on the filters since this can weaken such filters. Failure can also be caused by a excessive pressure loading across the inlet face of the filter as the result of vessel pressurization or high fan vacuum.

An accident is postulated where both stages of HEPA filters on an exhaust ventilation system fail. It is further postulated that the stack radiation monitor fails to alarm and the filter failure is not detected by operations personnel until 8 hours following the accident.[33] The probability for simultaneous failure of both stages of a HEPA filter bank, determined from Reference 34, is a 4.9×10^{-5} per HEPA filter year.

Consequences. Failure of a vessel ventilation exhaust filter could result in the release of all radioactive particulates contained on both stages of HEPA filters. It is assumed that the failed filters were in service on vessels containing maximum radionuclide concentrations associated with salt well pumping (1 Ci/ℓ ^{137}Cs, 2×10^{-2} Ci/ℓ ^{90}Sr) and with Z Plant neutralized waste (8.1×10^{-4} Ci/ℓ ^{239}Pu). It is also assumed that the filters had a radiation dose rate of 1,000 mR/hr. Based on data from Reference 34, the maximum release resulting from filter failure is calculated as 0.69 Ci ^{137}Cs, 0.01 Ci ^{90}Sr, and 5.6×10^{-4} Ci ^{239}Pu.

This would be considered "worst case." In recent experience, filters on 244-A (changed after 18 months of service) had a dose rate of only 3 mR/hr.

The calculated risk for this accident (frequency x consequences) is 3.4×10^{-5} Ci ^{137}Cs, 4.9×10^{-7} Ci ^{90}Sr, and 2.7×10^{-8} Ci ^{239}Pu per HEPA filter year. Dose commitments for the maximum individual and population, based on data from Reference 32, are shown in Table 10.

TABLE 10. Calculated Dose Commitment - Filter Failure.

Radionuclide	1 Year, rem			70 Years, rem		
	Whole Body	Bone	Lung	Whole Body	Bone	Lung
Maximum Individual						
^{90}Sr	7.8×10^{-5}	2.9×10^{-4}	2.4×10^{-4}	3.2×10^{-3}	1.2×10^{-2}	5.7×10^{-4}
^{137}Cs	7.6×10^{-3}	7.6×10^{-3}	1.3×10^{-3}	1.6×10^{-2}	1.7×10^{-2}	5.6×10^{-3}
^{239}Pu	8.4×10^{-6}	2.0×10^{-4}	1.1×10^{-3}	4.8×10^{-4}	1.0×10^{-2}	2.9×10^{-3}
Totals	7.7×10^{-3}	8.1×10^{-3}	2.6×10^{-3}	2.0×10^{-2}	3.9×10^{-2}	9.1×10^{-3}
Population						
^{90}Sr	1.6×10^{-1}	5.8×10^{-1}	2.4×10^{-1}	6.2×10	2.3×10^{1}	5.7×10^{-1}
^{137}Cs	$2.0 \times 10^{+1}$	$2.1 \times 10^{+1}$	3.4×10	$4.2 \times 10^{+1}$	$4.6 \times 10^{+1}$	$1.4 \times 10^{+1}$
^{239}Pu	8.4×10^{-3}	2.0×10^{-1}	4.8×10	4.8×10^{-1}	$1.0 \times 10^{+1}$	1.8×10
Totals	$2.0 \times 10^{+1}$	$2.2 \times 10^{+1}$	4.7×10	$4.9 \times 10^{+1}$	$7.9 \times 10^{+1}$	$1.8 \times 10^{+1}$

Detection. Failure of the filters and a resultant release of radioactive materials would normally be detected by the stack radiation monitor, which alarms locally and at an occupied location (e.g., 242-A 242-S, 244-AR). Such failure should also be detected by tank farm operations personnel evaluations of periodic differential pressure readings across the filters.

Corrective Action. On detection, the exhaust fan would be shut down, the failed filters replaced, tested, and the exhaust system returned to service. The failed filters would be packaged for burial as solid radioactive waste.

Effects on Other Systems. Salt well pumping and/or other transfers to or from the salt well waste receiver facilities would be shut down until the affected ventilation exhaust system was again operational.

9.3.2 Breach of Pump Pit and Primary Tank

Accident Scenario. An accident is postulated where, during removal or replacement of the pump pit cover blocks, a crane failure allows a cover block to fall. It is assumed that the block penetrates the pump pit floor and ruptures the primary tank resulting in a release of radioactive mist to the atmosphere. The Reactor Safety Study, WASH-1400,[34] states that the probability (frequency) of a crane failure is 3.0×10^{-6} per operating hour. Assuming that six associated DCRT pump pits are opened twice per year (12 entries - 2 hours crane time/entry closure), the frequency for this accident is calculated to be 7.2×10^{-5} per year.

Consequences. It is assumed that the impact and rupture releases the maximum concentration of salt well liquor and/or 234-5 Z Plant waste to the pump pit and tank vault atmosphere (465 m^3). It is further assumed that this pit-vault atmosphere is loaded with 33 Mg/m^3 of this waste[35], which is released to the environs (15.3 g = 15.3 cm^3 at specific gravity of 1.0 g/cm^3). This results in a release of 0.015 Ci ^{137}Cs, 3.0×10^{-4} Ci ^{90}Sr, and 1.2×10^{-5}Ci ^{239}Pu.

The calculated risk for this accident (frequency x consequences) is 1.1×10^{-6} Ci ^{137}Cs, 2.2×10^{-8} Ci ^{90}Sr, and 8.6×10^{-10} Ci ^{239}Pu per year. Since the consequences resulting from this accident are significantly lower than from the filter failure accident, dose commitment calculations were not made.

Detection. This accident would be detected immediately by personnel involved with opening and/or closing the pump pit.

Corrective Action. Personnel at the site would be surveyed for radioactive contamination or injury and evacuated for decontamination and/or treatment. Action would also be taken to provide a temporary cover for the pit opening until damage is assessed and a recovery plan is approved. Recovery could involve decontamination and repair or replacement of the facility.

Effects on Other Systems. Operations requiring use of the DCRT would be shut down until the primary tank was repaired, replaced, or alternate routings for waste were provided.

9.3.3 Criticality.

Low concentrations of fissile materials (primarily plutonium at $<1 \times 10^{-3}$ g/gal) are present in salt well liquor. Wastes resulting from operations at Z Plant, routed to the 102-SY waste storage tank via the 244-TX primary tank will contain plutonium, limited to ≤ 0.05 g/gal. By criticality prevention specifications,[36] such wastes are batch sampled, analyzed, neutralized and transferred from Z Plant in compliance with this specification.

The 244-TX primary tank is equipped with a recirculation pump to maintain precipitated solids in suspension, recirculation sluicing jets for removal of deposited solids during tank flushing, and neutron monitors under the tank bottom at regular intervals to detect retention and buildup of plutonium in the tank. Plutonium retention in the 244-S primary tank, which will receive drainage of flush solutions from the 244-TX - 102-SY waste transfer line, can be measured periodically or by request, using portable neutron detectors inserted via dry wells.

A criticality safety analysis covering the planned operation of the 244-TX and 244-S DCRT[37] indicates that the criticality safety controls provided meet the triple contingency requirements of Reference 38. A criticality accident in either the 244-S or 244-TX DCRT is considered to be very unlikely to occur.

9.3.4 Earthquake

Accident Scenario. It is assumed that the DCRT primary tanks, pump pits, etc., are subjected to the SSE which produces a maximum horizontal acceleration of 0.25 g accompanied by a vertical acceleration of two-thirds the horizontal. All DCRT and associated facilities were designed to withstand the SSE except for the previously designed and constructed 244-CR vault, which contains the 15,000-gallon 003-CR tank used as a DCRT. It is assumed that the 244-CR vault, its exhaust ventilation system, and the 003-CR tank are extensively damaged.

The probability for occurrence of the SSE is estimated to be between 4×10^{-4} and 1×10^{-3}/yr (average probability = 7×10^{-4}/yr) with recurrence times of 4,500 and 1,000 years, respectively.[2]

Consequences. It is assumed that the SSE damages the exhaust ventilation filters permitting the filter inventory to be released to the atmosphere. It is also assumed that the cover blocks fall into the vault and rupture the 15,000-gallon (56,775-liter) 003-CR tank containing salt well liquor (1 Ci/ℓ ^{137}Cs, 0.02 Ci/ℓ ^{90}Sr, 7.4×10^{-6} Ci/ℓ ^{239}Pu). The 244-CR vault atmosphere (831 m^3) is loaded with 33 Mg/m^3 of this waste which is released to the atmosphere. It is further assumed that recovery from this accident is not initiated for 2 weeks since recovery of other facilities could have higher priority. During this 2-week period, radioactivity from the salt well liquor could be resuspended and released to atmosphere with a resuspension flux[35] of 1×10^{-10}/sec. The releases resulting from this accident are shown in Table 11. Calculated dose commitments resulting from this accident are shown in Table 12.

TABLE 11. Radioactive Release - Earthquake Damage 244-CR Vault.

Radionuclide	Filter Failure, Ci	Entrainment, Ci	Resuspension, Ci	Total Ci
^{90}Sr	0.01	5.5×10^{-6}	0.14	0.15
^{137}Cs	0.69	0.03	6.9	7.6
^{239}Pu	5.6×10^{-4}	1.4×10^{-7}	5.0×10^{-5}	6.1×10^{-4}

The risk associated with this accident (frequency x consequences) is 1.0×10^{-4} Ci ^{90}Sr, 5.3×10^{-3} Ci ^{137}Cs, and 4.3×10^{-7} Ci ^{239}Pu per year.

TABLE 12. Calculated Offsite Dose Commitment - Earthquake Damage 244-CR Vault.

Isotope	1 Year, rem			70 Years, rem		
	Whole Body	Bone	Lung	Whole Body	Bone	Lung
Maximum Individual						
^{90}Sr	1.2×10^{-3}	4.4×10^{-4}	3.6×10^{-3}	4.8×10^{-2}	1.8×10^{-1}	8.6×10^{-3}
^{137}Cs	8.4×10^{-2}	8.4×10^{-2}	1.4×10^{-2}	1.8×10^{-1}	1.9×10^{-1}	6.2×10^{-2}
^{239}Pu	9.2×10^{-6}	2.1×10^{-4}	1.2×10^{-3}	5.2×10^{-4}	1.1×10^{-2}	3.1×10^{-3}
Totals	8.5×10^{-2}	8.9×10^{-2}	1.9×10^{-2}	2.3×10^{-1}	3.8×10^{-1}	7.4×10^{-2}
Population						
^{90}Sr	2.4×10	8.7×10	3.6×10	$9.3 \times 10^{+1}$	$3.4 \times 10^{+2}$	8.6×10
^{137}Cs	$2.2 \times 10^{+2}$	$2.3 \times 10^{+2}$	$3.8 \times 10^{+1}$	$4.6 \times 10^{+2}$	$5.1 \times 10^{+2}$	$1.6 \times 10^{+2}$
^{239}Pu	9.2×10^{-3}	2.2×10^{-1}	1.2×10	5.2×10^{-1}	$1.1 \times 10^{+1}$	3.1×10
Totals	$2.2 \times 10^{+2}$	$2.4 \times 10^{+2}$	$4.3 \times 10^{+1}$	$5.5 \times 10^{+2}$	$8.6 \times 10^{+2}$	$1.7 \times 10^{+2}$

Detection. Since seismic activity monitors are located at various places on the Hanford Site, an earthquake of much lesser intensity would be detected. However, detection of the onset of an SSE would be of little benefit since insufficient time would be available to shut down salt well pumping or reduce the inventory of waste in the 003-CR tank. Failure would be detected by inspection of the 244-CR vault.

Corrective Action. It must be assumed that other facilities would also fail as the result of the SSE. Initial corrective action, which would consist of covering the vault area to minimize continued radioactive release, would be scheduled and implemented based on priorities assigned to this and other recovery operations. Repair or replacement of the facility would be based on its continued need.

Effects on Other Systems. Pumping of salt wells in the 241-C farm tanks would be stopped until repair, replacement, or use of alternate facilities are provided.

9.3.5 Tornado

The probability for the occurrence of a tornado at the Hanford Site is 6×10^{-6}/yr.(1) Should a tornado strike these facilities, the above-grade instrument shelters and ventilation exhaust stacks could be destroyed or damaged without release of radioactive materials. Below-grade facilities are protected from tornado damage by 2-foot-thick, reinforced concrete cover blocks, except for the HEPA filters on the 244-A and 244-S. These below-grade filter cells are covered by a 3/8-inch steel plate, which could be displaced by rotational winds. Should this occur, these two filter systems could be damaged with resultant release of their radioactive particulate inventory.

Since 244-S and 244-A facilities are approximately 5 miles apart, the probability of both being damaged is very low. Should one HEPA filter system be damaged, consequences could be similar to those described for failure of ventilation filters; however, the risk from a tornado (frequency x consequences) is an order of magnitude less.

9.3.6 Flooding

The possibility and effects of floods and of heavy rains and snow on facilities located on the 200 Areas plateau have been previously analyzed and found to be of no concern.(39)

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10.0 CONDUCT OF OPERATIONS

Rockwell currently conducts operations at the DOE Hanford Site facilities near Richland, Washington, in accordance with and in fulfillment of Contract DE-AC06-77RL01030. Rockwell Hanford Operations is a subsidiary of the Energy Systems Group, Rockwell International Corporation. This contract, administered by the Richland Operations Office of DOE (DOE-RL), specifies that Rockwell will provide materials and services for certain identified operations within the Hanford Site. Rockwell is funded under this contract.

The corporate organization of the Energy Systems Group, a division of North American Space Operations, Rockwell International, is shown in Figure 11. The corporate organization of Rockwell is shown in Figure 12.

10.1 OPERATING ORGANIZATION

Operation of the salt well waste receiver facilities is under the direction of the Production Operations Function. Needed support is provided by other functional organizations. The responsibilities and authorities of each organizational component are described and defined.[20] Reference 20 also serves as the formal channel for communication of company policy and procedures which implement company, contractual, legal, and governmental requirements for operations of the assigned DOE-RL facilities.

10.2 PREOPERATIONAL TESTING AND PROCEDURES

The scope of the operability test procedures controlled by RHO-MA-115[40] includes actual tests of all instruments, alarms, motor control, ventilation and detection equipment, under operating or simulated operating conditions. Correction of observed deficiencies provides verification that the process facilities and equipment are operational. Operability test procedures provide the specific preoperational testing procedures used for startup of the facilities.

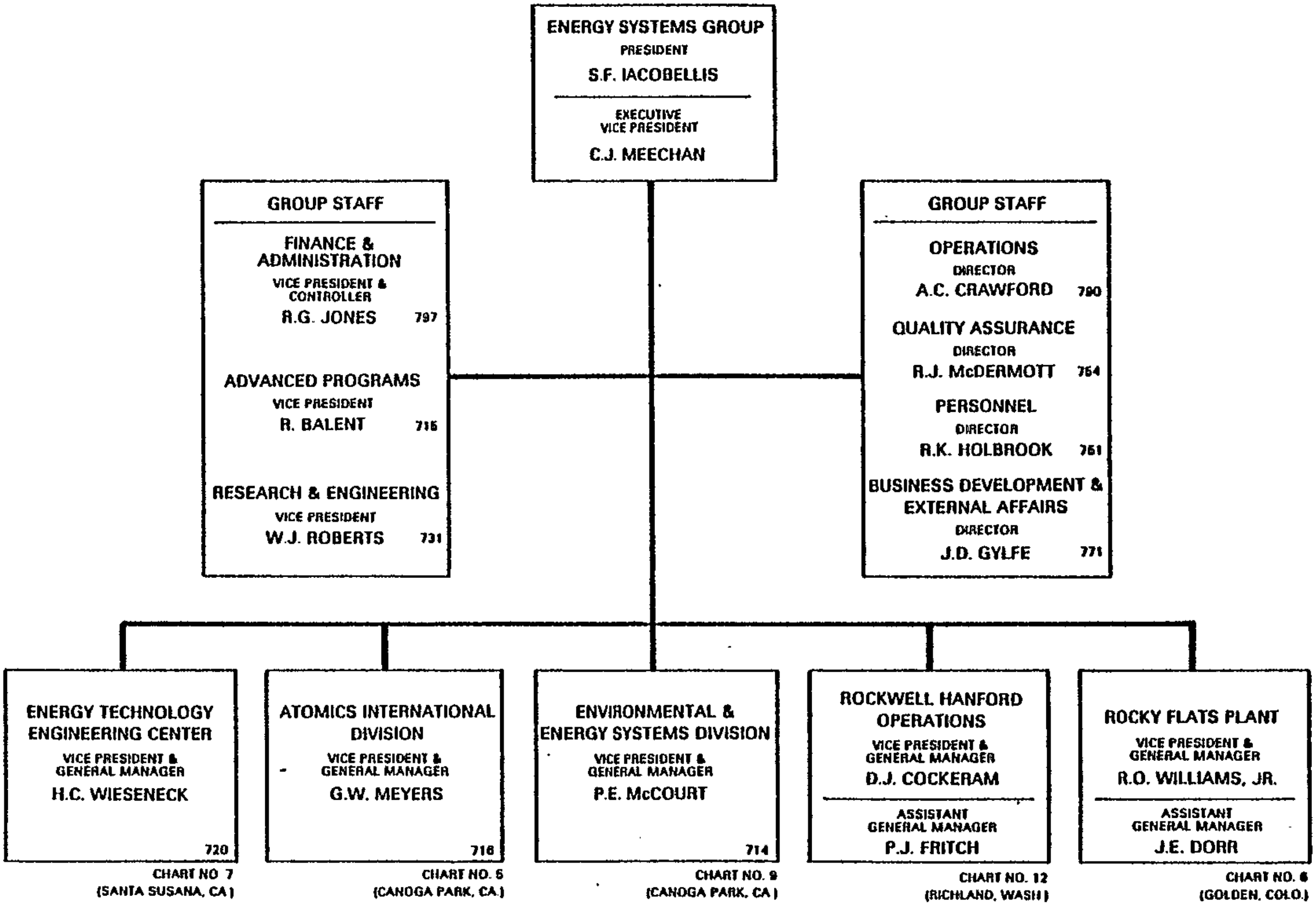

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FIGURE 11. Rockwell Organizational Chart.

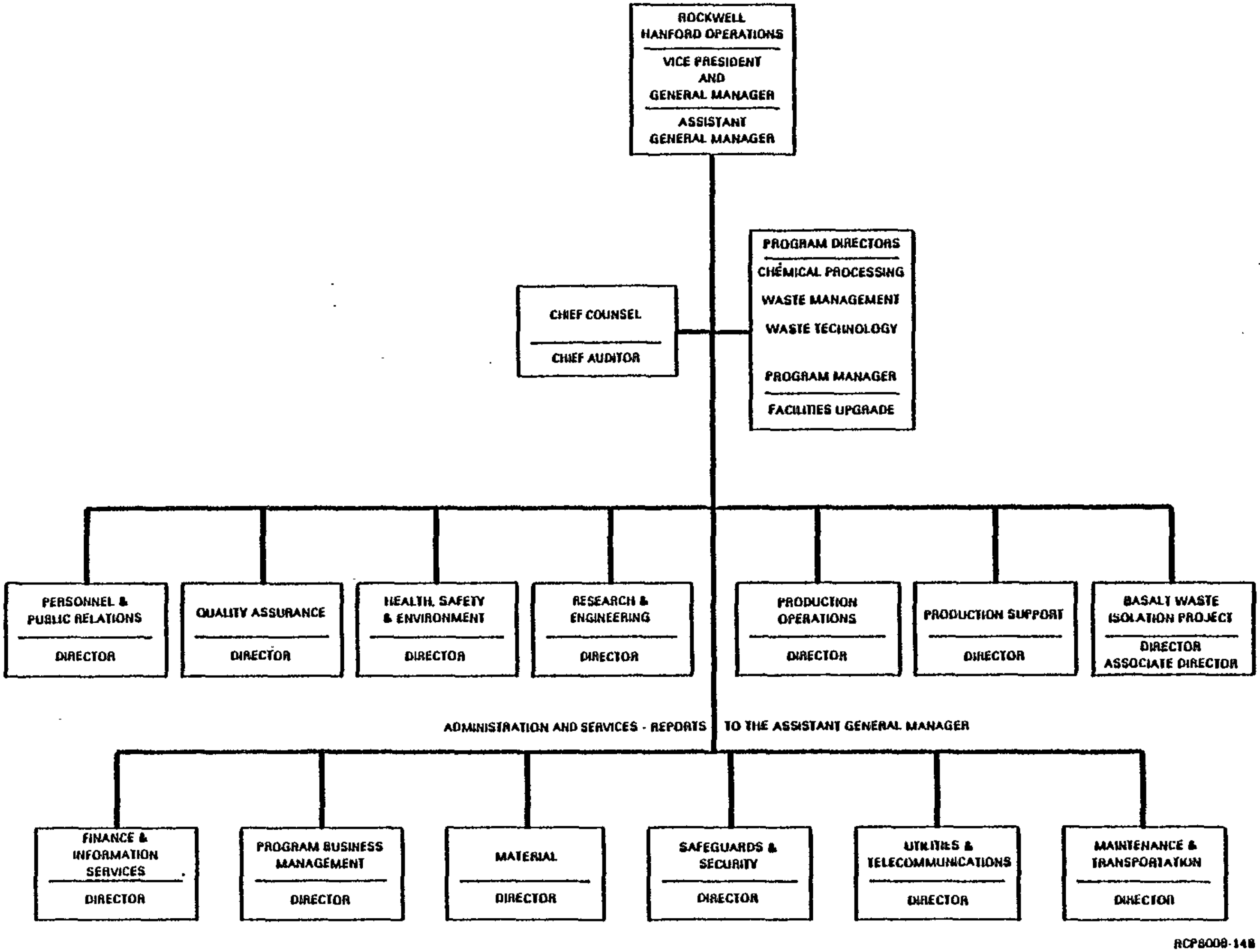

FIGURE 12. Rockwell Hanford Operations Organizational Chart.

The objectives of the operability tests include:

- identification and correction of construction deficiencies
- training of the operation and supervisory personnel
- demonstration of the operational readiness of the facilities on an integrated system basis.

The operability tests are conducted by Tank Farm Surveillance and Operations personnel in accordance with written test procedures prepared by Plant Engineering Department personnel.

10.3 TRAINING

It is the policy of Rockwell to establish planned formal and on-the-job training and to ensure that personnel are qualified to perform their duties in a safe, efficient, and effective manner. An individual shall not be assigned to perform work without the necessary training and qualifications.

Training programs associated with the operation of radioactive waste handling facilities provide employees with both the knowledge and skills required to perform assigned work. The training programs also prepare individuals to take prompt, effective action in response to abnormal or emergency conditions. Training for work assignments and possible emergency actions complies with all applicable regulations and DOE directives.

10.4 NORMAL OPERATIONS

Standard operating procedures (SOP)[41], which include Job Performance Aids, are prepared for all process operations associated with the salt well waste receiver facilities. Procedures require signature approval by Operations, Process Engineering, Radiological Protection, and Quality Assurance management personnel.

All SOPs are reviewed on a regular basis to assess their effectiveness and adequacy with respect to current facility operating modes and administrative requirements. Mandatory compliance with the procedures is required by the company and is regularly audited and documented by the Quality Assurance Department.

10.5 EMERGENCY PLANNING

Rockwell has developed and maintains emergency plans and procedures to cope with the consequences of potential accidents involving the Hanford Site functions for which the company is responsible.[30] Where appropriate, action level guidance is made part of operational procedures and specifications to indicate the required degree of response.

The Emergency Procedures Manual[30] provides basic information on methods of coping with many types of emergencies. These procedures define the actions to be taken, including specific individual responsibilities, to achieve protection of personnel, facilities, and the environment.

Emergency Procedures, "Radioactive Gaseous Discharges - Tank Farms," and "Radioactive Liquid Discharges - Tank Farms," are directly concerned with the operational safety of these tank farm facilities. They provide the bases for defining emergency occurrences, and required actions. Specific responsibilities are delineated for supervisory, radiation monitoring, and engineering support personnel to cope with the occurrence.

10.6 DECOMMISSIONING

At the end of the useful life of the salt well waste receiver facilities or the adoption of a long-term isolation program, it is assumed that the tanks and pits will be internally decontaminated, removed, and the site backfilled with clean fill and revegetated. It is further assumed that contaminated tank components will be packaged and buried in a conventional manner. Excavated contaminated soil and concrete rubble will be transported to burial trenches.

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11.0 OPERATIONS SAFETY REQUIREMENTS

Operations Safety Requirements (OSR) define conditions, safe boundaries, and management and design controls to assure safe operation of the applicable facilities. Both technical and administrative requirements are provided. Operations Safety Requirements related to technical matters address features of the facilities of controlling importance to safety. Those OSR related to administrative matters include organizational and functional requirements important to establishing and sustaining safe operating conditions. The OSR presented are binding for operations in the salt well waste receiver facilities. Any revisions to the limits and controls, or any changes in operating conditions or facility and/or equipment modifications which involve an unreviewed safety question or increase the likelihood or consequences of an accident will require a revision or supplement to this report. Operations Safety Requirements for 241-AN-101 are provided in Reference 42.

11.1 METHODOLOGY

The OSR in this report derive from a three-stage analysis. The facilities and operations were inductively analyzed by formal hazards analysis. Those events identified as posing potential risk to operating personnel, facility and equipment, the environment or to the general public, were deductively analyzed using fault trees. The preventive measures and controlling features (or barriers) identified in the analyses were grouped into two categories of facility-wide requirements. The former constitute safety limits for operation and are documented by procedure and operating standard. The latter constitute the subsequent OSR and are the general controls which the facility procedures and operating standards serve to maintain.

The relationships between the levels of controls and the facility analyses are illustrated in Figure 13.

BARRIER/ CONTROL		• PROCEDURF	• MASS BALANCES • INSTRUMENTS • OPERATING STANDARDS	• VAULT/CONFINEMENT SYSTEMS • PROCESS SPECIFI-CATIONS	• DISTANCE • OSRs
FACILITY CONDITION	NORMAL OPERATION	MINOR DEVIATION	ABNORMAL OPERATION	RELEASE WITHIN VAULT	FINAL CONTAINMENT/ CONFINEMENT LEAK PATH
EVENTS			• OVERFLOW • SPILLS, LEAKS • NONESSENTIAL EQUIPMENT FAILURES	• LINE/VESSEL LEAK • LOSS OF VENTILATION	• LOSS OF EXHAUST GAS MONITORING/SAMPLING • LOSS OF EXHAUST FILTRATION • NUCLEAR CRITICALITY

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FIGURE 13. Relationship Between Levels of Control - Facility Accident Analysis.

11.2 SAFETY LIMIT AND LIMITING SETTING

The requirements in this category apply to (1) those restrictions established in values such that, if the limit is not exceeded, no serious consequence will occur, and (2) continuously monitored variables that directly relate to the integrity of the final system barriers.

11.2.1 Fissile Material Limits

Applicability. This requirement applies to receiver stations 244-S and 244-TX.

Objective. Criticality safety in the applicable tanks is assured by compliance with criticality specification T-6 or RHO-MA-149.[36].

Requirement.

1. Maximum plutonium concentration in batch solutions routed to the applicable tank shall be 0.05 g/gal.
2. Maximum plutonium inventory in each tank shall be 2,000 g.

Basis. The 244-TX receives alkaline waste from Z Plant. Waste transfers may also take place from 244-TX to 244-S.

Based on data in Reference 37, it is determined by analysis that the limits effectively preclude the possibility of a nuclear criticality. Assurance that this requirement is satisfied is provided by records which are maintained of plutonium transferred into 244-TX from Z Plant and by administrative and surveillance controls which are in place to preclude plutonium accumulation in 244-TX.

Recovery. In the event this requirement is violated, all transfers of radioactive liquid waste involving the affected tank shall cease. The area manager shall notify the managers of Tank Farm Processing Operation and Tank Farm and Evaporator Process Control. The latter shall notify appropriate management including Manager, Criticality Engineering and Analysis. A recovery plan which is in accordance with Nuclear Criticality Standard No. VIII or RHO-MA-136[38] shall be prepared and formally approved by Rockwell Hanford Operations management.

11.2.2 Continuous Effluent Air Monitoring and Alarm Limit Settings

Applicability. This requirement applies to the continuous monitors and associated alarms on the exhaust stacks for the following facilities:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement specifies contir... monitoring of, and alarm settings for, the applicable facility exh...

Requirement. Gases in the facility exh... stack shall be monitored continuously for gross beta-gamma activit... ...d for alpha activity on 244-S and 244-TX). The monitors shall ...ide visual and audible alarms at levels not to exceed 4 MPC-hr (eq... ...ent to that stated in Reference 3 for ^{137}Cs beta-gamma or ^{239}... ...lpha for a period of 4 hrs).

Basis. The isotopes spec... as the basis for alarm are the most radiologically significant r... ...sentatives of the beta-gamma and alpha emitter categories. OSR ... .1 provides the surveillance requirements for this OSR.

Recovery. In ... event that this requirement is violated, specified continuous monit... alarm settings shall be promptly reestablished or radioactive m... ...al transfers involving the affected facility shall cease. The ... manager shall immediately notify the managers of Tank Farm Pro... ...ng Operation and Tank Farm and Evaporator Process Control. Further n...ifications shall include Manager, Effluent Controls Group. Resumption of operations shall require satisfying this requirement and formal concurrence of Rockwell Hanford Operations management.

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11.3 LIMITING CONDITIONS FOR OPERATION

The requirements in this category cover safety related equipment and technical conditions and characteristics of the applicable facilities. Minimum performance levels are established for safety related equipment. Technical conditions and characteristics are specified in terms of limiting feed composition.

11.3.1 Radioactive Solution Composition

Applicability. This requirement applies to all radioactive waste solution transfers through the following facilities:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement precludes conditions exceeding the design bases.

Requirement. Radioactive waste solutions shall satisfy the tank content specification limits of Process Specifications 2.1.1 in Section I of Reference 43.

Basis. The nitrite, nitrate, and hydroxide concentrations are limited to inhibit pitting, corrosion, and stress corrosion cracking. If these phenomena are not controlled, deterioration of the DCRT and piping may occur at a faster rate.

Recovery. In the event that this requirement is violated, all operations on the effected facility shall cease or be curtailed as appropriate. The area manager shall immediately notify the managers of Tank Farm Processing Operation and Tank Farm and Evaporator Process Control. A recovery plan shall be prepared and formally approved by Rockwell Hanford Operations management to restore the facility to within requirements.

11.3.2 Off-gas HEPA Filters

Applicability. This requirement applies to the exhaust sy...

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement is i... ...sure that radioactive aerosols generated within the a... ...ities pass through two effective stages of HEPA f...

Requirement ... ...austed from the applicable facilities shall pass throu... ...of HEPA filtration rated separately at an efficien... ...or more for particles greater than 0.3 μm diameter whenever ...ctive solutions are transferred into, out of, or through the system.

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Basis. The requirement derives from design bases considerat[illegible]. The design basis aerosol challenge to the exhaust gas filt[illegible] requires two stages of HEPA filtration, each rated at an effic[illegible] 99.95% to assure that ventilation exhaust gas radioactivit[illegible] [illegible]ss than Table II concentration guides of Reference 3. The [illegible]ance requirement for this limiting condition is specified [illegible] 11.4.2, HEPA Filter Testing.

Recovery. Upon determi[illegible] that this requirement is not being met, all transfers int[illegible], or through the facility shall cease. The area manager [illegible] immediately notify the managers of Tank Farm Processing [illegible], Tank Farm and Evaporator Process Control, and Efflue[illegible]trol Group. Resumption of operations requires compliance w[illegible] requirement, surveillance requirements (OSR 11.4.2), and formal approval by Rockwell Hanford Operations management.

11.3.3 Effluent Gas Sampling

Applicability. This requirement applies to the contin[illegible] stack samplers in the exhaust stacks for the following facilit[illegible]

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement specifies c[illegible]uous sampling of effluent gases.

Requirement. Gases in the applic[illegible] exhaust stacks shall be sampled for particulate activity. Each sam[illegible] shall continuously collect samples which shall be analyzed for gros[illegible]a-gamma (and alpha for 244-S and 244-TX). Record samples sha[illegible] taken on a weekly frequency not to exceed 2 weeks and be ana[illegible].

Basis. Continuo[illegible]mpling of the exhaust gases and analysis of these samples are [illegible]red to identify radioactive emissions, detect abnormal releas[illegible] [illegible]terns which might indicate deteriorating filter efficiencie[illegible] confirm compliance with release limits.

Re[illegible]. In the event that this requirement is violated, all opera[illegible] involving radioactive materials shall cease or be curtailed, as appropriate. The area manager shall immediately notify the managers

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of Tank Farm Processing Operation, Tank Farm and Evaporator Process Control, and Effluents Control Group. Operations shall remain suspended until the requirement is met.

11.4 SURVEILLANCE REQUIREMENTS

This category applies to surveillance requirements for those systems and components essential to maintaining safe operation and mitigating the consequences of accidents. Requirements for test, calibrations or inspections, to verify performance and availability of equipment required for safety are specified.

11.4.1 Effluent Air Monitors and Alarms

Applicability. This requirement applies to the continuous monitors and associated alarms on the exhaust stacks for:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement is intended to specify the functional test frequency for the detector and associated alarms.

Requirement. Monitors and alarms for the applicable exhaust stacks shall be functionally tested on a monthly frequency not to exceed 45 days with a sealed radioactive source.

Basis. Continuous monitoring of exhaust air activity and alarms at specified levels are required to provide notification and initiate corrective actions if excessive activity concentrations should occur. This surveillance requirement is provided to assure compliance with OSR 11.2.2, Continuous Effluent Monitoring and Alarm Limit Settings.

Recovery. In the event the stack monitors and alarms are not tested within the frequency and scope specified in the requirement, the area manager shall immediately notify the managers of Tank Farm Processing Operation, Tank Farm and Evaporator Process Control, and Effluents Control Group. The test shall be performed as specified within 5 working days or operations with radioactive materials in the facility shall be halted at that time. Upon completion of the test, demonstration of compliance with OSR 11.2.1, for Continuous Effluent Air Monitoring and Alarm Limit Settings, and formal approval by Rockwell Hanford Operations management, operations may resume.

11.4.2 HEPA Filter Testing

Applicability. This requirement applies to the HEPA filters in the following exhaust systems:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement is intended to assure that the HEPA filters in place and new HEPA filters installed meet a minimum removal efficiency of 99.95% for particles greater than [illegible] m diameter.

Requirement. HEPA filters shall be tested using standard dioctyl-phalate (DOP) test techniques (or equivalent) following replacement and annually thereafter, with intervals not exceeding 15 months. If the tests demonstrate an efficiency of less than 99.95%, the filters shall be replaced before further work involving radioactive material is performed in areas served by the filters.

Basis. The efficiency of a HEPA filter is determined by challenging the filter and housing frame with DOP aerosol (or equivalent) on the inlet side and measuring the DOP in the outlet side exhaust stream. This requirement is provided to assure compliance with the OSR 11.3.2, Off-gas HEPA Filters.

Recovery. In the event one or both exhaust filters are not tested within the frequency and scope specified in the requirement, the area manager shall immediately notify the managers of Tank Farm Processing Operations, Tank Farm and Evaporator Process Control, and Effluents Control Group. The test shall be performed as specified within 5 working days or operations with radioactive materials in the affected facility shall be halted at that time. Resumption of operations shall require completion of the specified tests, demonstration of compliance with the OSR 11.3.2, Off-gas HEPA Filters, and formal Rockwell Hanford Operations management approval.

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11.5 DESIGN FEATURES

This category of OSR covers design characteristics of special importance to maintaining adequate control and containment and confinement of hazardous materials. Crucial to this protection is modification and change control to assure that safety related matters are adequately reviewed and counterchanges made as necessary.

11.5.1 Review and Approval of Facility Modifications

Applicability. This requirement applies to the following systems in the salt well receiver facilities:

- ventilation systems and equipment
- radiation shielding structures and features
- structures and partitions which serve to contain radioactive contamination
- installed radiation detection and alarm systems.

Objective. This requirement defines control of design and system modifications.

Requirement. Modifications to systems and equipment in the applicable categories shall be reviewed and approved by responsible operating management, Process Control Engineering, the safety organization, and Quality Assurance, before being implemented.

Any modifications judged to represent an unreviewed safety question or to involve a change in the OSR of this document shall be the subject of supplement to, or revision to the safety analysis report, which shall be approved per Rockwell Hanford Operations Policy and by DOE, prior to implementation of the modification.

Basis. The need for review and approval of modifications to systems and equipment is specified by Reference 44.

Recovery. In the event it is determined that an unreviewed modification has been performed which represents an unreviewed safety question or involves a change in the OSR of this document, affected operations of the facility shall be halted immediately or curtailed, as appropriate.

The Managers, Tank Farm Surveillance and Operations Department, Radiological Protection Department, and Environmental Analysis and Monitoring Department shall be notified immediately. The modifications shall be reviewed as specified. The affected operations shall remain shut down until the modification is covered by appropriately approved safety documentation.

11.6 ADMINISTRATIVE CONTROLS

This category of OSR pertains to the various administrative controls significant to the safe operation of the salt well waste receiver facilities. The OSR consist of summary commitment statements and administrative arrangements for unusual events, operating and control documentation, and training. Nothing in this section restricts changes in organizational titles or organizational assignments within these limits.

11.6.1 Criticality Protection Specifications

Applicability. This requirement applies to the waste solutio[illegible] transfers into, out of, and through the following salt well waste [illegible] facilities:

244-A	244-S	244-U
244-BX	244-TX	244-C[illegible]

Objective. This requirement assures [illegible]ar criticality safety.

Requirement. Nuclear critical[illegible]tection specifications (CPS) shall be prepared and approved [illegible]y operation in the applicable facilities involving fissile mat[illegible] Approvals required are: (1) the specification author, (2[illegible]ager, Criticality Engineering and Analysis or his delegate, an[illegible] acceptance by the managers of Tank Farm and Evaporator Proc[illegible]ntrol and Tank Farm Processing Operation (or their delegates). [illegible] specifications shall be reviewed every 2 years (not to exceed [illegible]chs) for continued adequacy and applicability. Any revised spec[illegible]cion must receive the above formal approvals.

Basis. The requirement for CPS is defined by Reference 45, Appendix Part II.

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Recovery. In the event that an operation is being performed which is not covered by a properly approved CPS, that operation shall be immediately halted or curtailed, as appropriate. The situation shall be immediately brought to the attention of the area supervisor, who, in turn, will notify the Managers, Tank Farm Processing Operation, Tank Farm and Evaporation Process Control, and Criticality Engineering and Analysis. Properly approved CPS shall be in place before the operation may continue.

In the event an existing approved CPS has not been reviewed and/or revised as required, the above managers shall be notified. With the concurrence of the Manager, Criticality Engineering and Analysis, the CPS shall be reviewed and/or revised as necessary within 3 working days without interruption of the operation. If the CPS is not revised within the 3-day period, the operation shall be halted and shall not resume until the CPS is revised and formally approved.

11.6.2 Operating Procedures

Applicability. This requirement applies to all operations involving radioactive materials in the following salt well waste receiver facilities:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Requirement. The Research and Engineering Function shall prepare, release, control, and maintain operating procedures. Procedure approvals shall include: (1) Tank Farm and Evaporator Process Control, (2) the responsible Production Operations Function, (3) the Quality Assurance Function, and (4) the Health, Safety, and Environment Function. Operating procedures shall be reviewed by the Research and Engineering Function every 30 months, not to exceed 33 months. If changes are required, a revised procedure shall receive the above formal approvals.

Basis. The requirement for operating procedures is defined in Reference 44.

Recovery. In the event that an operation is being performed which is not covered by a properly approved operating procedure, that operation shall immediately be halted or curtailed, as appropriate. The violation shall immediately be brought to the attention of the area manager who, in turn, will notify the Managers, Tank Farm Processing Operation, and Tank Farm and Evaporator Process Control. When a formally approved procedure is in place, operations may resume with the concurrence of the above respective managers.

In the event an existing approved operating procedure has not been reviewed and/or revised as required, the managers of Tank Farm Processing Operation and Tank Farm and Evaporator Process Control shall be notified. The procedure shall be reviewed and/or revised as necessary within 3 working days without interruption of the operation. If the review and/or revision is not accomplished within the specified time, the operation covered by the procedure shall be halted and may not commence until the requirement is satisfied and approval has been granted by the respective managers above.

11.6.3 Trained Personnel

Applicability. This requirement applies to personnel conducting operations with radioactive materials in the following salt well waste receiver facilities:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement defines the minimum training requirement.

Requirement. Employees shall be trained in the basics of the processes, system design, and construction, as appropriate, system operation, and emergency procedures and response.

Basis. The Rockwell training program conforms to Reference 44 and Reference 46 Appendix Part II, which require that critical tasks be performed by formally trained and qualified personnel.

Recovery. In the event it is determined that a task is being performed by an employee who does not meet this requirement, the responsible area manager shall either discontinue that activity or assure that a properly trained and qualified employee is present.

11.6.4 Unusual Events

Applicability. This requirement applies to unusual events in the operations of the following salt well waste receiver facilities:

244-A	244-S	244-U
244-BX	244-TX	244-CR

Objective. This requirement assures that significant occurrences of a safety related nature are adequately identified and reported.

Requirement. If operations take place outside the bounds of these OSR, the operations shall immediately cease or be curtailed, as appropriate. Rockwell Hanford Operations management shall be notified promptly of the violations and shall, in turn, notify DOE-RL. An investigation shall be made and a complete analysis of the circumstances leading up to, and resulting from the situation, with recommended actions to prevent recurrence, shall be formally reported to DOE-RL.

In the event of other unusual or unplanned events (as defined by Reference 31), actions to be taken shall be as specified.

Required notification shall be per established Rockwell Hanford Operations and DOE-RL procedures for both requirements 1 and 2:

1. The area manager shall be promptly notified and will, in turn, notify the managers of Tank Farm Processing Operation, Tank Farm and Evaporator Process Control, and Radiological Protection.

2. Reporting to DOE-RL shall be in accordance with established procedures in References 31 and 47.

Basis. Unusual occurrence reports provide a format for accident investigations. They also provide a mechanism for rapid dissemination of information to functional and program groups so that steps can be taken to assure that similar events do not recur. Action levels and investigation/reporting requirements are established by References 31 and 47.

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12.0 QUALITY ASSURANCE

It is Rockwell policy[20] that the requisite level of quality throughout all areas of contract performance be maintained. An independent function, Quality Assurance, acts in a variety of ways to implement this policy.[17] The scope of Quality Assurance activities includes those required to ensure quality in training, planning, design, development, procurement, fabrication, production, handling, storage, maintenance, calibration, certification, and acceptance.[48,49] Readiness reviews are required to assure preparations are adequate and complete for the startup of new or modified facilities being restarted after extended shutdown or shutdown for cause.[48,49]

During operations, Quality Assurance activities include:

- procedure review and approval
- design review and approval for facility changes
- inspection planning and inspection of facility changes
- audits to insure compliance with operating procedures and specifications
- procure document control
- supplier approval and inspection and testing of procured items
- inspection planning and approval for Rockwell-fabricated items
- NCR identification and resolution
- record control of facility changes, procured items, and fabricated items
- identification of conditions requiring corrective actions and initiation of corrective action requests.

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